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TROPICAL AGRICULTURE is published monthly at the Imperial College of Tropical Agriculture, St. Augustine, Trinidad, West Indies. Advertisement and subscription rates can be obtained at the College from the Editor, or from the Secretary of the College, 14, Trinity Square, London, E.C. 3, England. The Editor will be glad to consider authoritative articles for publication. It is understood that opinions expressed or recommendations made in signed articles or in articles of which the source is named are those of the author and do not necessarily represent the policy or opinion of the College Authorities. Increasing numbers of inquiries are being received from the various parts of the tropics which can be answered only by persons possessed of an intimate knowledge of local conditions. Enquirers should first satisfy themselves that their local Department of Agriculture is not able to supply them with the desired information before communicating with us. Correspondence which will be replied to is invited on all other matters pertaining to tropical agriculture, science and development.

WATER CONSERVATION.

IN normal years the subject of the weather as a topic of casual conversation is a commonplace with all grades of society. At times like the present when so large an area of the world is suffering from exceptional drought, the vagaries of climate become a matter of the deepest concern which is reflected in the widespread comments of the press. A critical period of this kind helps to impress on the average citizen a more conscious realization of the dependence of his life on water supplies both at home and in distant countries. We are still very little less dependent on the wiles of nature for our daily bread than were our primitive forbears whom we call uncivilised. The crops of to-day are probably fewer and certainly more fastidious in their requirements than the semi-wild food plants which formed the diet of the population of yesterday. Big strides have been made in the improvement of the plant itself, its food value and yield per acre have been raised enormously by breeding and by the provision of an efficient though semi-artificial environment. But advances along these roads have been quite disproportionate to our ability to control the variations of climate—variations, that is, which are in excess of the normal and which, at various periods in history, have manifested themselves all too strikingly over considerable tracts of the globe.

Presumably because of the long duration of the present drought some writers have been tempted to prophesy the initiation of a permanent change in world climatic conditions. We read of such seemingly fantastic projects as the conversion of the sea into fresh water and of other means of augmenting the deficient supply. These arguments are mainly derived from a study of weather statistics gleaned over a number of years, and the discovery of supposed trends is based on the computation of average or mean values. Whilst it is true that such averages can possess certain comparative value when obtained over a reasonable term of years' records, nevertheless the use of averages over an arbitrary period is beset with many pitfalls. From the agricultural standpoint, a year, though a convenient unit of time, is too long a period to take into full consideration the variations in distribution covering the 365 days which comprise it, and it is this annual fluctuation in rainfall which most concerns the grower of crops. Recently, however, the United States Weather Bureau has reassured us that there is no reason to suppose that the present abnormal figures

indicate a permanent drift towards desert-like conditions. More important, records indicate a cycle of 30 to 40 years when severe drought may be expected to recur.

On the opposite hand, there is probably some justification for a certain amount of the criticism levelled at municipal authorities or those entrusted with the public water supply for their slowness in accepting the idea of a serious shortage, and consequently delay in taking the necessary action. It is not intended here either to vindicate or to censure this criticism, merely to offer what seems a plausible explanation for such an attitude of mind. Health departments and their like having large areas to administer, must make use of district records which are averages both for the area concerned and over the customary time periods. Those are the figures upon which they must base their policy, and they can doubtless lay good claim to obtaining a fairly accurate general picture of conditions over the area they serve. It is not implied, of course, that these competent authorities are unaware of the maxima and minima, but it is suggested that the exigencies of large-scale administrative work of this kind perforce entails a disregard for the contingency of extremes. Perhaps when more is known of the cyclic recurrence of extremes we shall have less cause to criticise, for we should then be adequately forewarned; but in the absence of that knowledge it would be gratifying to feel that our equipment was not insufficient to cope with possible climatic disasters.

But the agriculturist cannot look to the local or national authorities for supplying his crops with water beyond the point at which the general scheme of natural or irrigation water supply affects his own property. He has many problems in the conservation of water which only he can tackle. In the very first instance, when the task of choosing suitable land has to be faced, considerations of aspect, slope, drainage, soil texture, height of water-table and precipitation—all factors in water supply—comprise the chief desiderata of selection. To say that water supply is the limiting factor of crop yields is almost a truism, but nevertheless a very significant view-point to assimilate. It means that when the yield of a particular crop has fallen below a certain point, further outlay of capital in cultivation or manures will be unprofitable. The solution lies either in irrigation or in growing an alternative, more drought-resistant crop. The modern idea of irrigation requires enormous capital expenditure which no single individual could normally invest. Viewed on the scale of the great irrigated tracts of America or India, for example, works of this kind are essentially capitalist or national in character. But to the small holder who has no recourse to any such cooperative supply, a study of the primitive methods of water lifting and transport, such as are still in use by the Chinese coolie or Egyptian fellah, might well be considered in times of water stress. At first sight objects of incredulity, their "devices" should ultimately evince admiration for their efficiency relative to cost of erection and maintenance.

The undertaking of a thorough soil survey which would link rainfall data to the water requirements of the plant—by assessing the importance of surface run-off, depth of percolation, fluctuations in level of subsoil water, capillary forces and other pertinent facts—should be as much an essential preliminary to the formulation of a water conservation scheme as the engineer's surveys of land levels and natural sources of supply. Rainfall is without doubt a useful statistic in certain cases, but without the relevant data concerning evaporation, rate of entry into the soil, and sundry other factors it is comparatively useless as an index of the amount of water available to the plant. The rapid strides which in recent years have been made in the field study of soil conditions in relation to vegetation should be taken advantage of by considering them in conjunction with meteorological records in the formulation of national schemes of conservation.

The area affected by the drought in America is continent-wide, and the relief measures already instituted may seem, to those who are accustomed to insular conditions, to be on an equally prodigious scale. In the early months the drought was rather welcomed as likely to alleviate the problems of unsaleable stocks, and to bring about a rise in crop prices. Its persistent severity has now shattered that complacent attitude. Press reports relate that over two million cattle in stricken areas have been bought by Government which is slaughtering them at the rate of 200,000 a week for the provision of canned meat to be distributed to the starving. Assisted migration and other temporary palliatives of a political tone indicate that the situation is now very seriously regarded. Of a more permanent nature, the great dams on the Missouri and Columbia rivers, originally designed to prevent floods and provide electric power, are to be utilised in great irrigation schemes. Here is provision against both climatic extremes, and the success of this single scheme to serve a dual purpose will doubtless be watched with much interest. Certainly no less concern will be shown in the outcome of their other major project for providing a windbreak stretching across the continent from the Canadian border to Mexico, a forest covering 20 million acres comprised of mile-wide strips, each 1,000 miles long. This gigantic experiment raises the important general issue of the relation between forests and water conservation. The problem gains additional interest in the light of the much-disputed question as to whether or not the presence of a forest can increase or otherwise influence precipitation. No scientific proof has yet been adduced to prove this point, but from what evidence exists it seems that such effect as it may exert is relatively insignificant by contrast with

the influence of a forest on soil and plant evaporation, and its prevention of excessive surface erosion by holding up the flow of water down steep-sided slopes.

The dry season in the tropics is typically associated with the steady blowing of the Trade Winds which are an added menace to the risks of drought. The extent of mechanical wind damage is, however, probably in many cases outweighed by the loss in yield which follows excessive evaporation. In addition, wind over large open tracts blows off the top layers of soil with serious loss of fertility. Islands are as a rule protected along their windward coasts by wind-break reserves. But here, as with water supply, the onus is on the individual planter to protect his crop from the prevailing winds. If he has no natural barrier in forest or mountain range, he must plant his own wind-break. For this purpose he has only commonsense to guide him in the selection of suitable trees. There is unfortunately a very striking lack of knowledge on this question—scientific data is urgently required to answer questions such as rates of growth, branching habit, root-system and spacing distances, which might help in the selection of a wind-break which at the same time will not unduly impoverish the soil. Probably the ideal form of wind-break, bearing in mind the utility of leguminous species, is one made up of a central row of tall trees, smaller trees on either side, and outside these again dwarf bushes to fill up the gaps between the lower branches. This type will give an inclined surface to divert the air currents upwards. There is scope for interesting research here, and such studies should form an integral problem in water conservation.

Drought resistance in plants is not a simple attribute, but the result of the interplay of a number of complex physiological factors. Some of these find expression in external morphological characters, such as reduced transpiring surface, hairiness, sunken stomata and others, which we call "xerophytic"; but more important are the internal factors, such as an increased osmotic pressure of the cell sap, which enable the plant to obtain sufficient water from heavily depleted soil reservoirs. It should not be overlooked, moreover, that the possession of a deep root-system is just as much a xerophytic character under certain circumstances as, for example, succulence or a prostrate habit. Breeding for drought resistance is thus not a straightforward issue, but one requiring highly specialised knowledge, such as the Russian botanists have been pursuing with such energy during the past few years. This intricacy is but another facet to the general problem of water conservation, a problem urgently in need of greater co-operative effort on the part of engineers, botanists, soil chemists, meteorologists, physiologists and geologists alike. Thirty to forty years is none too long a period if agriculture is to be prepared to combat the next world drought in the rainfall cycle, better than it has weathered this one.

AGAVE AMANIENSIS.

A new form of fibre producing Agave from Amani.

By W. NOWELL.

(*Kew Bull. Misc. Infor.*, No. 10, 1933, pp. 467-7.)

This *Agave* has been cultivated at the East African Agricultural Research Station under the name *A. Lespinassei* Trelease. Mr. Nowell, finding that it did not agree with the original description of that species, sent specimens to Kew, whence they were submitted to Professor Trelease, who considers it to be an undescribed form belonging to the *Zapupe* group. A description drawn up by Mr. Nowell and Professor Trelease is published. Pending a genetical investigation of the group the new form has been given specific rank under the name *Agave amaniensis*. This species, whose origin seems likely to remain obscure is markedly superior to *Agave sisalana* in rapidity of growth and size of leaf. It achieves a gain over the latter of six to twelve months in the date of first cutting. An increased rate of production is likely to be maintained. Mature leaves have an average length of 150 cm. and have a great practical advantage in the absence of marginal spines. It has not yet been known to pole, and propagation is at present effected by suckers which are produced freely after two years. The fibre compared with sisal fibre is much finer and longer, running from 4 to 5½ feet in length. Although the average tensile strength of sisal fibres is greater owing to their much greater thickness, when calculated to equal cross sectional area the fibre of *A. amaniensis* has about 1½ times the tensile strength of sisal. The brushed fibre is described as lustrous, white to creamy white in colour with a pleasant soft texture. It is considered that this *Agave* may have an important future as a fibre-producing plant. Small commercial plantings have already been made on estates at Magunga and Amboni.—(*Imp. Bur. of Fruit Prod., Hort. Abstracts*, Vol. IV, No. 1, 1934, p. 39.)

Ransomes at the Royal Show (1934).

The representative display of agricultural machinery exhibited by Ransomes, Sims & Jefferies, Ltd., of Ipswich at this year's Royal Show included a number of implements of special interest to the export visitor. Of these, possibly the most remarkable was the "Shugadisc" TD. 9A which is a veritable giant among ploughs, primarily designed for sugar-cane growers, carrying four 30-inch discs mounted on roller bearings, the whole weighing nearly 3 tons. It is, nevertheless, a one-man outfit with the tractor. A cultivator, designed for use with tractors up to 50 h.p., was another of the exhibits, and built on similarly massive lines. Harvesting machinery, seed drills and many other types of implements went to make up the very varied range exhibited by this firm.

VARIATION IN THE SIZE OF TRINIDAD CACAO BEANS AND METHODS OF ITS ASSESSMENT.

By A. W. Paterson, N.D.A. and R. L. Reed, B.Sc. (Lond.).

The question of the size of Trinidad cacao beans was brought into the limelight by the work of the Cacao Research Scheme, one of their criteria of selection being that the trees selected should produce not only high yields but large bold beans. In order to co-ordinate this work with the needs and desires of the chocolate manufacturers, Professor C. Y. Shephard and Mr. F. J. Pound carried out a series of grading experiments, the results of which were discussed with cacao brokers and manufacturers in the United Kingdom during the Summer of 1933. These experiments dealt only with a portion of the 1932-33 Trinidad main crop and as further information was required concerning the variation, if any, occurring in the course of a crop year, additional measurements were made at the Imperial College of Tropical Agriculture during the subsequent season. The investigation was divided into two parts, one to discover by actual measurement of beans the extent of variability in size which could be attributed to the progress of the crop season, and the other to prepare a picture of Trinidad cacao from an analysis of the distribution of bean size. The latter forms the subject matter of the present paper.

The material used was obtained from the Cocoa Planters' Association of Trinidad and Tobago which handles only the fully fermented, carefully prepared produce of estates with a reputation for high quality cacao. The general bulk of this is sold as "C.P.A. Plantation", but a few estates, producing a high percentage of large beans, separate out a grade known as "C.P.A. Superior". The amount of this is comparatively small but when occasion offered samples were taken and measured for the purpose of comparison.

Since there was no method known of assessing the size of cacao beans other than by measurements of the three dimensions—length, breadth, and thickness—together with the weight of a known number of beans, this procedure was adopted. The authors were aware of the Gold Coast method of using a standard container as a measure of size but no data was available as to its accuracy or the degree of variability it would show. Accordingly, it was arranged to take and measure for the first experiment 5 samples of 200 beans of "C.P.A. Plantation" each month, as far as possible a sample each week, in order to discover any variations within the Trinidad main crop. The bulking and mixing of the produce of different estates at the Cocoa Planters' Association greatly facilitated the sampling process. The procedure adopted to ensure that this small quantity was representative of the general bulk, was to mix a large number of random samples and then to reduce this to the requisite size by quartering. The bulked samples so obtained were used for this investigation.

Comparison of "Plantation" and "Superior" Grades.

The distribution of the 5,000 beans of "Plantation", for the five months from November 1933 to March 1934, in length classes is contrasted below with that of 2,500 beans of "Superior" together with the respective mean breadths and thicknesses for each class, where that represents above 5 per cent. of the total.

Table I.

Distribution by lengths in mm. Classes.

Trinidad Plantation (5,000 *beans*).

	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12
	—	13	22	72	166	264	503	782	812	896	677	389	228	111	35	12	11	2	5
Mean Breadth ..	—	—	—	—	—	13.8	13.6	13.2	12.9	12.6	12.23	11.92	—	—	—	—	—	—	—
Mean Thickness ..	—	—	—	—	—	8.0	7.7	7.7	7.6	7.5	7.6	7.5	—	—	—	—	—	—	—

Mean Length 21.69 mm.

Trinidad Superior (2,500 *beans*).

	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12
	2	13	43	91	162	250	375	454	369	343	207	107	49	26	5	3	1	—	—
Mean Breadth ..	—	—	—	—	14.3	13.99	13.64	13.45	13.11	12.83	12.70	—	—	—	—	—	—	—	—
Mean Thickness..	—	—	—	—	9.01	9.10	9.16	9.25	9.35	9.43	9.71	—	—	—	—	—	—	—	—

Mean Length 22.78

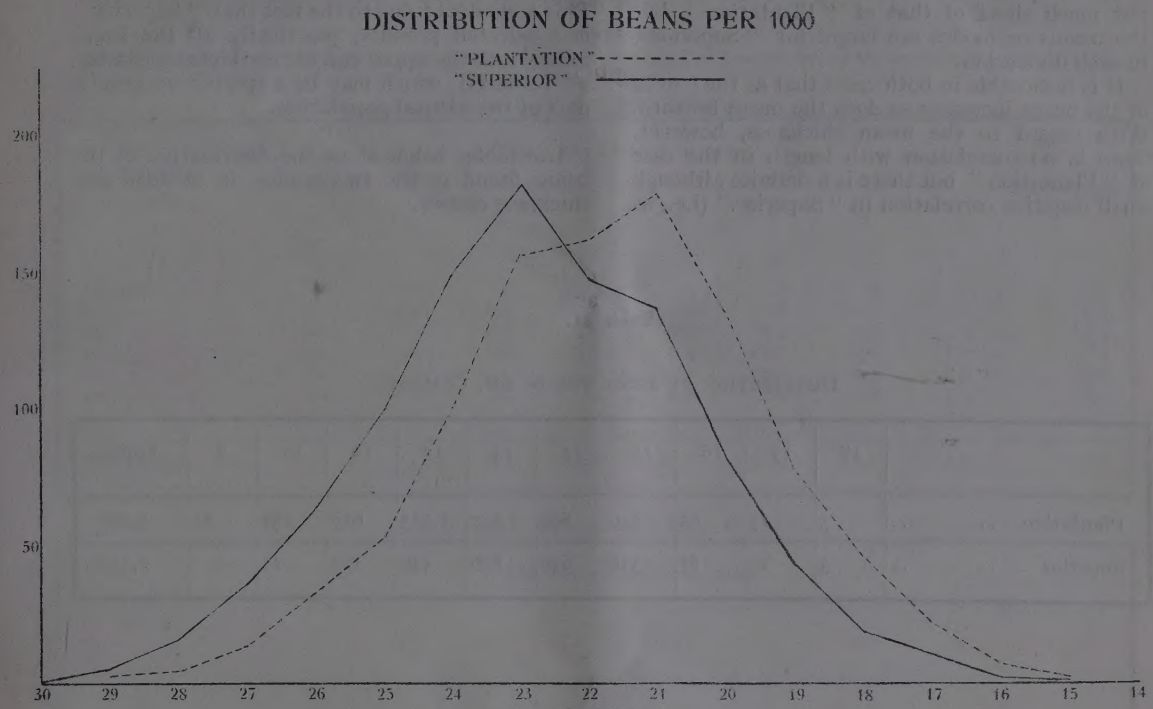

Fig. 1.—Length in mm.

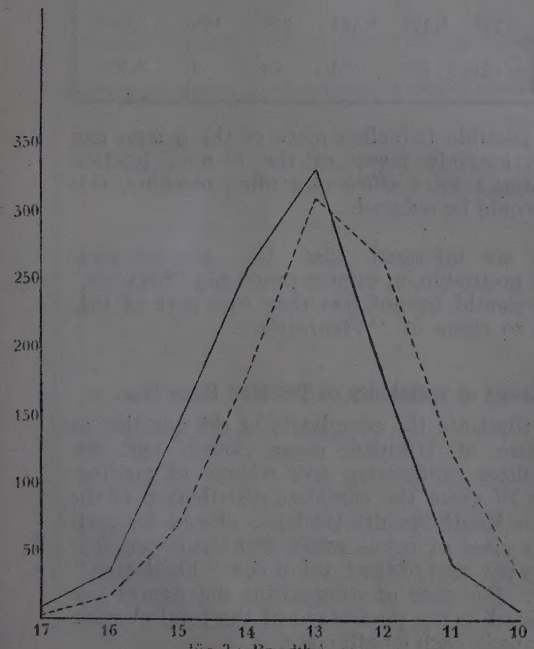

Fig. 2.—Breadth in mm.

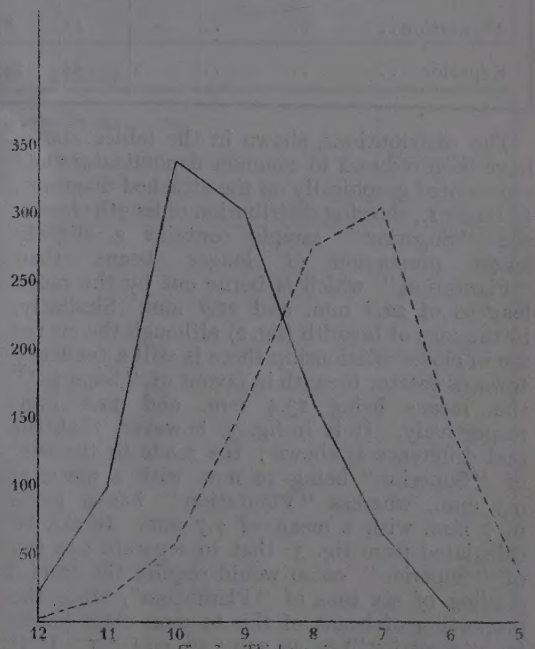

Fig. 3.—Thickness in mm.

The range of length classes of "Superior" is not much short of that of "Plantation" but the means or modes are larger for "Superior" in each dimension.

It is noticeable in both cases that as the length of the beans increases so does the mean breadth. With regard to the mean thickness, however, there is no correlation with length in the case of "Plantation" but there is a definite although small negative correlation in "Superior." (i.e., as length increases, the mean thickness decreases). This is no doubt due to the fact that "Superior" is a selected product, practically all the beans falling into the upper end of the thickness classes, *see* Table III, which may be a specialised genetic part of the natural population.

The tables below show the distribution of the beans found in the two grades, in breadth and thickness classes.

Table II.

DISTRIBUTION BY BREADTHS IN MM. CLASSES.

	18	17	16	15	14	13	12	11	10	9	Total.
Plantation	5	13	85	346	890	1,547	1,315	617	157	25	5,000
Superior	3	20	87	356	640	826	446	105	17	—	2,500

Table III.

DISTRIBUTION BY THICKNESS IN MM. CLASSES.

	13	12	11	10	9	8	7	6	5	Total.
Plantation..	—	11	87	285	798	1,376	1,524	720	199	5,000
Superior	2	55	247	849	752	405	164	24	2	2,500

The distributions, shown in the tables above, have been reduced to common denominators and represented graphically on the attached diagrams. In figure 1., showing distribution of length classes, the "Superior" sample contains a slightly larger proportion of longer beans than "Plantation" which is borne out by the mean lengths of 22.8 mm. and 21.7 mm. Similarly, in the case of breadth (fig. 2) although the curves are in closer relationship there is still a tendency towards greater breadth in favour of "Superior," the means being 13.4 mm. and 12.8 mm. respectively. It is in fig. 3, however, that the real difference is shown; the mode in the case of "Superior" being 10 mm. with a mean of 9.3 mm., whereas "Plantation" has a mode of 7 mm. with a mean of 7.7 mm. It can be calculated from fig. 3 that to separate one ton of "Superior" cacao would require the careful grading of six tons of "Plantation", since the proportion of beans of the 10 mm. class (mode for "Superior") is as 340 : 56 or 6 : 1. If it were possible to include more of the 9 mm. and proportionately fewer of the 8 mm. fraction by using a more efficient grading machine, this ratio could be reduced.

We are informed that the present ratio found profitable on estates producing "Superior" cacao should be not less than one part of this grade to three of "Plantation".

Range of variability of Trinidad Bean Size.

To illustrate the complexity of the question of the size of Trinidad cacao beans and the difficulties confronting any scheme of grading, Table IV gives the complete distribution of the various length-breadth-thickness classes for each length class of beans which represents not less than 5 per cent of the total of the "Plantation" grade. For ease of comparison the figures are expressed as the percentage of the total number of beans in each length class.

Table IV.

TRINIDAD PLANTATION CACAO.

Distribution of beans in length-breadth-thickness classes expressed as percentages of the number of beans in each length class.

LENGTH 19 MM. (389 BEANS).

Breadth. Class	Thickness Classes in mm.								Percentage.
	12	11	10	9	8	7	6	5	
15 mm	—	—	.5	.3	.5	.3	.5	—	2.1
14 ,, ...	—	1.0	1.0	.5	1.0	.8	—	—	4.3
13 ,, ...	—	—	2.3	4.9	6.2	6.4	3.3	.3	23.4
12 ,, ...	—	.8	1.6	3.9	6.4	11.8	5.7	1.7	31.9
11 ,, ...	—	.3	1.5	2.8	6.7	10.8	5.4	2.3	29.8
10 ,, ...	—	—	—	.2	2.1	2.6	1.8	1.3	8.0
9 ,, ...	—	—	—	—	—	.2	.3	—	.5
Percentage ..	—	2.1	6.9	12.6	22.9	32.9	17.0	5.6	100.0

LENGTH 20 MM. (677 BEANS).

Breadth. Class.	Thickness Classes in mm.								Percentage.
	12	11	10	9	8	7	6	5	
16 mm.	—	—	—	—	.1	—	.2	—	.3
15 ,, ...	—	—	.3	.4	.7	.6	.2	—	2.2
14 ,, ...	—	.3	1.3	1.3	2.1	3.3	.6	.1	9.0
13 ,, ...	.2	1.1	1.2	3.9	8.1	8.5	2.5	.4	25.9
12 ,, ...	—	.4	1.4	5.3	10.8	13.9	5.0	2.0	38.8
11 ,, ...	—	—	.6	2.7	4.0	6.5	3.5	1.5	18.8
10 ,, ...	—	—	.4	.4	.9	1.5	1.3	.2	4.7
9 ,, ...	—	—	—	.2	—	—	.1	—	.3
Percentage ..	.2	1.8	5.2	14.2	26.7	34.3	13.4	4.2	100.0

LENGTH 21 MM. (896 BEANS).

Breadth. Class.	Thickness Classes in mm.								Percentage.
	12	11	10	9	8	7	6	5	
17 mm.	—	—	.1	.1	—	—	.1	—	.3
16 ,, ...	—	.1	—	.1	.2	.2	.1	.1	.8
15 ,, ...	—	—	.3	.8	1.3	.8	.3	—	3.5
14 ,, ...	—	.1	1.6	2.0	3.3	3.5	1.3	.1	11.9
13 ,, ...	.2	.3	1.9	6.4	8.0	11.0	3.6	1.0	32.4
12 ,, ...	—	.4	1.7	4.1	10.2	9.6	7.6	2.4	36.0
11 ,, ...	—	.1	.6	1.7	2.5	3.9	2.8	1.2	12.8
10 ,, ...	—	—	.1	.1	.4	.5	.1	.6	1.8
9 ,, ...	—	—	—	—	—	.1	.1	.2	.4
Percentage ..	.2	1.0	6.3	15.3	24.9	29.6	16.0	5.6	100.0

Table IV.—CONTINUED.

LENGTH 22 MM. (812 BEANS).

Breadth. Class.	Thickness Classes in mm.								Percentage.
	12	11	10	9	8	7	6	5	
17 mm.	—	—	—	—	—	—	—	—	—
16 ,, ...	—	—	—	.2	.1	.1	.1	—	.6
15 ,, ...	—	—	.2	1.9	1.5	1.0	.2	.1	4.9
14 ,, ...	.1	.2	1.5	3.2	6.9	5.3	2.5	.7	20.3
13 ,, ...	—	.7	1.5	4.8	11.7	11.0	7.0	1.1	37.0
12 ,, ...	—	.5	1.5	5.3	5.2	11.0	3.9	1.3	28.7
11 ,, ...	—	—	.5	1.2	2.0	2.3	1.0	.5	7.5
10 ,, ...	—	—	—	.1	.3	.1	.4	.1	1.0
Percentage ..	.1	1.5	5.2	16.7	27.6	30.8	14.3	3.8	100.0

LENGTH 23 MM. (782 BEANS).

Breadth. Class.	Thickness Classes in mm.								Percentage.
	12	11	10	9	8	7	6	5	
17 mm.	—	—	—	—	—	.1	—	—	.1
16 ,, ...	—	—	.1	.4	1.0	.5	.3	—	2.3
15 ,, ...	—	.1	.5	1.9	1.8	2.8	.8	—	7.9
14 ,, ...	.3	1.0	1.3	5.2	6.1	8.1	1.9	.5	24.4
13 ,, ...	.2	.8	2.0	6.4	12.3	10.6	6.5	1.2	40.0
12 ,, ...	—	—	.9	2.3	6.4	6.7	4.1	.5	20.9
11 ,, ...	—	—	.4	.4	1.0	1.5	.6	—	3.9
10 ,, ...	—	—	—	—	.1	.1	.3	—	.5
Percentage ..	.5	1.9	5.2	16.6	28.7	30.4	14.5	2.2	100.0

LENGTH 24 MM. (503 BEANS).

Breadth. Class.	Thickness Classes in mm.								Percentage.
	12	11	10	9	8	7	6	5	
18 mm.	—	—	—	.4	—	—	—	—	.4
17 ,, ...	—	—	—	—	.2	.4	—	—	.6
16 ,, ...	—	—	.2	1.0	1.2	.4	.4	—	3.2
15 ,, ...	—	.2	.8	2.2	4.2	3.9	1.0	.4	12.7
14 ,, ...	—	1.0	1.0	5.9	10.9	11.5	3.9	.8	35.2
13 ,, ...	—	.8	1.0	4.8	11.3	9.5	3.6	.6	31.6
12 ,, ...	—	.4	.8	3.0	3.2	3.3	2.8	.2	13.5
11 ,, ...	—	—	—	.8	1.0	.6	—	—	2.4
10 ,, ...	—	—	—	.2	—	.2	—	—	.4
Percentage ..	—	2.4	3.8	18.3	32.0	29.8	11.7	2.0	100.0

Table IV.—Continued

Length 25 mm. (264 Beans).

Breadth. Class.	Thickness Classes in mm.								Percentage.
	12	11	10	9	8	7	6	5	
17 mm.	—	—	.3	—	.4	.4	—	—	1.1
16 ,, ...	—	.4	.4	1.1	2.6	.8	—	—	5.3
15 ,, ...	—	—	1.5	6.8	3.8	4.2	2.3	.7	19.3
14 ,, ...	—	.8	2.3	6.0	8.7	7.6	4.2	.4	29.9
13 ,, ...	—	1.5	2.7	9.5	9.5	6.0	3.0	.4	32.6
12 ,, ...	—	—	.7	1.6	3.8	1.9	1.1	.4	9.5
11 ,, ...	—	—	.4	—	.4	.4	.4	.7	2.3
Percentage ..	—	2.7	8.3	25.0	29.2	21.3	10.9	2.6	100.0

Table IV shows that there are about 40 breadth-thickness classes within each of these 7 length classes. Further, only in 14 cases does more than 10 per cent. of any length class occur in one breadth-thickness class. For the purpose of convenience the percentages of breadth classes occurring within each length class, as shown in Table IV, have been embodied in Table V below. Length-thickness classes have been similarly dealt with in Table VI.

Table V.

Percentages of Beans of given length in Breadth Classes.

Breadth Class.	19	20	21	22	23	24	25
18 mm.	—	—	—	—	—	.4	—
17 ,, ...	—	—	.3	—	.1	.6	1.1
16 ,, ...	—	.3	.8	.6	2.3	3.2	5.3
15 ,, ...	2.1	2.2	3.5	4.9	7.9	12.7	19.3
14 ,, ...	4.3	9.0	11.9	20.3	24.4	35.2	29.9
13 ,, ...	23.4	25.9	32.4	37.0	40.0	31.6	32.6
12 ,, ...	31.9	38.8	35.0	28.7	20.9	13.5	9.5
11 ,, ...	29.8	18.8	12.8	7.5	3.9	2.4	2.3
10 ,, ...	8.0	4.7	1.8	1.0	.5	.4	—
9 ,, ...	.5	.3	.4	—	—	—	—

Table VI.

Percentages of Beans of given length in Thickness Classes.

Thickness Classes.	19	20	21	22	23	24	25
12 mm.	—	.2	.2	.1	.5	—	—
11 ,, ...	2.1	1.8	1.0	1.5	1.9	2.4	2.7
10 ,, ...	6.9	5.2	6.3	5.2	5.2	3.8	8.3
9 ,, ...	12.6	14.2	15.3	16.7	16.6	18.3	25.0
8 ,, ...	22.9	26.7	24.9	27.6	28.7	32.0	29.2
7 ,, ...	32.9	34.3	29.6	30.8	30.4	29.8	21.3
6 ,, ...	17.0	13.4	16.0	14.3	14.5	11.7	10.9
5 ,, ...	5.6	4.2	5.6	3.8	2.2	2.0	2.6

From Table V it can be clearly seen that between 62-68 per cent. of the beans of each length class are to be found in two breadth classes; the gradual increase in breadth as length increases again being shown by the mode moving from between the 11 and 12 mm. mark for a length of 19 mm. to between 13 and 14 mm. for those of 25 mm. in length.

Table VI shows that from 54-62 per cent. of the beans in each length class also fall into two thickness classes. The mode of the individual thickness classes, however, remains steadily at 7 mm. from 19-23 mm. but in the last two classes it moves to 8 mm. and displays a further upward inclination. Beans of a thickness of 9 mm. show a decided tendency to become more numerous as the length increases, whereas the trend in the case of those of 6 mm. is in the reverse direction. This would appear to contradict the statement on page 4. The explanation is not obvious but may be concerned with the fact that "Superior" beans, *i.e.* those with a relatively higher thickness, are only a part of the total population separated by mechanical means. The thicker fraction of Trinidad "Plantation" beans has undoubtedly more Criollo in its constitution, and hence may show totally different correlations from the Calabacillo types which form the opposite end of the population.

Size of Beans in relation to commercial Value.

In "The Kind of Cacao the Manufacturer Wants" published by the Office International des Fabricants de Chocolat et de Cacao in their Journal for July, 1933, the section dealing with desirable characteristics strongly emphasises the value of plumpness in cacao beans and states that "after the botanic variety, the skill shown in the preparation for the market is the most important factor in determining quality and price". The Botanical Section of the Cacao Research Scheme has shown the complexity of the botanical origin of Trinidad cacao, and this no doubt accounts for the great variation in size of Trinidad cacao beans.

The effect of preparation on the size of cacao beans is of the greatest importance, more particularly on beans from those varieties with larger proportions of the Calabacillo strain in their constitution whose plumpness is very largely controlled by the skill exercised in their preparation. Preparation can be divided into two processes—fermentation and drying. Thorough and even fermentation for a period varying according to the type, and slow careful drying to prevent the collapse of the turgid tissues following a too rapid removal of water, are essential. From a few measurements made of beans before drying but after fermentation, and again when dry, it was evident that there was twice as much shrinkage in thickness, as in length or breadth. It would appear that care exercised in drying, provided the beans have been sufficiently fermented, can do much to control plumpness.

Manufacturers desire uniformly plump beans because such beans give an improved flavour and can be roasted more evenly. Moreover, many or at least some of them are prepared to consider that payment should be made on the basis of size and purity. In recent publications,* a good deal of space has been devoted to the question of size, and perhaps the most important of these was an article by V. Vilstrup, Director of F.D.B. Chocolate Manufacture at Kolding, Denmark, in which he postulated a Cacao Index as a standard for dealings in Accra cacao. Vilstrup divides his index into two portions; the Provisional Index which deals with size alone and a second part in which deductions may be made on the basis of purity. It is the former which is of special interest here. It is obtained by taking 100 beans and adding together their mean thickness multiplied by 10, mean length and mean breadth each multiplied by 2, together with their weight in grams.

The introduction of a system of definite standards for the purchase of cacao on a somewhat similar basis to that of other commodities such as cotton would doubtless be welcomed by everyone interested. The Vilstrup Index, however, is never likely to become popular whilst it necessitates the measuring of three dimensions of 100 beans from each sample, as well as the weight of 100 beans in grams. As we have seen, Trinidad cacao beans cover an extremely wide range of variability in size and in order to test thoroughly Vilstrup's Provisional Index and other methods which we will refer to later, it was decided to segregate as many beans as possible into definite length-breadth-thickness classes. All beans that measured between 6.5 and 7.5 mm. in thickness 20.5 and 21.5 mm. in length, 12.5 and 13.5 mm. in breath were placed in the class denoted by 7×21×13. The results have been very regular which indicates that the measurements and methods of assessment used have been accurate. The values of beans of different sizes according to Vilstrup's Provisional Index are shown in Table VII.

In Vilstrup's Provisional Index thickness is weighted against length and breadth in the proportion of 5 : 1 but Table VII shows that this is counteracted to a very considerable extent by the inclusion of the weight of 100 beans. Beans of 7×23×12 (248) are the equivalent of beans of 7×22×13 (251), 7×21×14 (252), 8×22×11 (248), 8×23×12 (250), 8×21×13 (253), 9×20×11 (249), and 9×19×12 (251).

**Office International des Fabricants de Chocolat et de Cacao*, March 1933, June 1933.

Table No. VII.

VILSTRUP'S PROVISIONAL INDEX.

Thickness Classes	6 mm.				7 mm.					8 mm.					9 mm.					10 mm.				
Breadth Classes in mm.	11	12	13	14	11	12	13	14	15	11	12	13	14	15	11	12	13	14	15	11	12	13	14	15
Length Class 19	—	—	—	—	206	218	228	—	—	223	233	243	—	—	244	251	259	273	—	—	—	—	—	—
20	197	206	213	—	216	228	239	246	—	229	242	253	262	—	249	261	272	277	—	265	275	286	298	—
21	204	213	222	230	222	234	243	252	262	239	250	260	268	282	257	267	278	290	298	278	285	295	308	—
22	211	220	229	240	235	242	251	262	271	248	258	267	278	288	264	273	285	298	306	282	292	302	316	322
23	—	226	238	245	—	248	258	270	278	257	266	276	286	299	—	284	296	308	318	287	300	312	324	334
24	—	—	—	—	—	255	268	276	—	—	272	283	293	304	—	287	300	314	326	—	307	319	335	344
25	—	—	—	—	—	262	270	282	293	—	276	291	303	314	—	300	308	323	332	—	317	330	338	354
26	—	—	—	—	—	—	280	292	306	—	—	297	310	322	—	—	318	328	339	—	—	—	—	—

Methods of rapidly assessing mean bean size of a commercial sample as an aid to valuation.

One of the authors from his association with the Gold Coast suggested that the method in use there of using a standard container and counting the number of beans therein, should be tested.

The use of an ordinary Capstan 50 cigarette tin (such as one can buy almost anywhere in the Tropics) as a measure of the size of cacao beans, originated in the Gold Coast during the season 1932-33 when the beans being produced were undoubtedly smaller than usual. During the following season, 1933-34, the number of beans in this measure (14 cu. ins.) with the addition of the number of beans per quarter lb. was given on the Gold Coast inspection certificates. That the number of beans required to fill a Capstan cigarette tin level full, any beans projecting when the tin is levelled off with a light ruler being removed, has proved a useful index of size is proved from the statistics of the Gold Coast Department of Agriculture. The mean size of the beans for the Main crop, 1932-33, was indicated by the fact that it required 136.4 beans to fill the standard measure when the Minor crop, 1933, required 146.4 beans.* Again the method has proved itself sensitive to changes by showing that the beans in 1933-34 are clearly larger than those in 1932-33, the figures† for Accra being:

	Oct.	*Nov.*	*Dec.*
1932	132.4	137.2	139.3
1933	122.3	124.8	123.7

In order to determine the effect of changes in the three dimensions on Gold Coast standards sufficient numbers of beans of each length-breadth-thickness class were segregated and the numbers per standard container of 14 cu. ins. and per quarter of a pound, respectively, were ascertained. It was found that whilst the number per container alone gives an indication of size irrespective of dimensions, the addition of the number of beans per quarter pound gives a better indication of the thickness. The explanation of this is that a plump, well fermented bean with large air spaces in the cotyledons should be less dense than a more compact poorly fermented bean. A long, broad, thin bean may give the same number per container as a shorter, narrower and plumper bean, but the number per quarter pound is much higher and brings out this difference. (*See* Table VIII.)

On close examination, these figures reveal that the Gold Coast method indicates not only size but also thickness. A further proof of this is the clear differentiation between the C.P.A. grades, "Plantation" averaging 127.5 to the container and 100.6 to the quarter-pound whilst the corresponding figures for "Superior" are 100.7 and 81.3. The writers have ventured to postulate in Table IX approximate size measurements for Trinidad cacao beans from the combination of these two criteria.

Table VIII.

Number of beans per 14 cu. ins.	Number of beans per ¼ lb.	Size of Beans.	Number of beans per 14 cu. ins.	Number of beans per ¼ lb.	Size of Beans.
189	139	6–20–12	117	90	8–22–14
176	131	6–21–12	116	87	8–24–13
163	122	7–20–12	115	92	9–23–12
156	116	7–21–12	114	91	9–22–13
152	114	6–22–13	112	86	8–23–14
146	108	7–21–13	111	91	10–22–12
144	107	6–23–13	109	90	10–21–13
144	109	7–22–12	109	83	8–24–14
143	109	8–21–12	109	85	8–25–13
139	107	8–20–13	109	88	9–21–14
138	104	7–23–12	106	84	9–23–13
137	102	7–22–13	105	84	9–22–14
135	104	8–22–12	104	83	9–24–13
134	101	8–21–13	103	86	10–22–13
130	97	7–23–13	103	79	8–25–14
129	99	8–23–12	100	78	8–24–15
127	95	7–22–14	100	80	9–23–14
126	97	8–22–13	99	81	10–23–13
124	93	7–24–13	97	77	9–24–14
124	96	8–21–14	97	80	10–22–14
124	98	9–22–12	93	78	10–24–13
121	90	7–23–14	92	76	10–23–14
121	94	9–21–13	90	74	10–25–13
119	91	8–23–13	—	—	—

* *Gold Coast Farmer*. Vol. II, No. 11. March, 1934.

† Gold Coast. Cacao Crop Prospect Report—December, 1933.

The procedure adopted in framing this scale was to utilise the data already in our possession from all the samples of "Plantation" and "Superior." This provided two fixed points on which the scale could be based. Although Table VIII, shows considerable overlap of different thickness classes, there is a general trend throughout which enables one to gauge the mean bean size, within limits, from the two statistics—beans per 14 cu. ins., and beans per ¼ lb.

Table IX gives the values over the range explored.

Table IX.

Number of beans per 14 cu. ins.	Number of beans per ¼ lb.	Approximate size of beans.
163–180	123–134	6 × 21 × 12
148–162	113–122	6.5
136–147	105–112	7 × 21.5 × 12.5
126–135	97–104	7.5
116–125	90–96	8 × 22 × 13
108–115	85–89	8.5
101–107	81–84	9 × 23 × 13
95–100	78–80	9.5
90–94	75–77	10

It occasionally happens that number of beans per ¼ lb. lies outside the values quoted for a particular number per 14 cu. ins. Where this is higher, the beans are thicker than expectation, e.g. 100/82 are thicker than 9.5 being in fact 9.6; where lower, the converse holds and beans of 110/80, for example, are thinner than 8.5 mm., being in fact only 7 mm.

The amount of time taken to test a sample, even by counting the number of beans in five containers and five quarter pounds, is very much less than measuring 100 beans, and moreover, the degree of accuracy required is such that much less highly paid employees—even illiterates—can count beans whilst a certain amount of technical skill is required to take the necessary measurements and weighings for the Vilstrup Index.

In order to obtain a proof of the value of the scale postulated in Table IX nine samples representative of commercial Grenada cacao were obtained and analysed. All these samples were obtained from consignments ready for export, five representing well known estate marks and the remainder different mixed commercial grades.

These fgures show that although the beans from both growths have practically the same thickness, Trinidad beans are longer and broader. It could not be expected, therefore, that the scale postulated in Table IX, could be applied directly to Grenada cacao. It is pleasing to note, however, that the variation between actual thickness and estimated thickness is constant; the apparent exception, sample G, being a border line case. Such irregularities could doubtless be eliminated if the scale was specifically adjusted to the range of size of Grenada cacao beans. The regularity of these results is a clear proof of the value of this method of size assessment.

Summary.

1. It is shown that Trinidad cacao contains a wide range of bean sizes.

2. "Superior" beans differ from "Plantation" most markedly in thickness.

3. Size of beans to a large extent determines quality, and simple statistics of number of beans per ordinary Capstan Cigarette tin and number of beans per ¼ lb. have proved valuable in the case of the more homogeneous Gold Coast cacao. The present paper shows these statistics are of great value in determining bean size in the more heterogeneous Trinidad cacao.

4. The advantage of this system is that it can be quickly and easily carried out by unskilled labour with a minimum of equipment.

5. A scale for estimating the average thickness of a sample of Trinidad cacao beans from these data is postulated.

6. The validity of the scale and its adaptability to other growths are proved by the analysis of samples of Grenada cacao.

Table X.

Sample.	Length in mm.	Breadth in mm.	Thickness in mm.	No. of Beans per 14 cu. ins.	No. of Beans per ¼ lb.	Approx. size estimated from Table IX.
A	21.4	12.4	7.9	142	109	7 mm.
B	21.1	12.3	7.8	143	108	7 ,,
C	21.0	12.3	7.7	145	112	7 ,,
D	20.4	12.1	7.7	150	114	6.5 ,,
E	20.5	12.0	7.6	154	117	6.5 ,,
F	20.4	11.9	7.6	150	118	6.5 ,,
G	20.9	12.1	7.5	146	112	7 ,,
H	20.6	12.0	7.5	156	115	6.5 ,,
I	20.1	11.9	7.4	161	122	6.5 ,,
Means	20.8	12.1	7.6	150	114	
Trinidad Plantation ..	21.7	12.8	7.7	127.5	100.6	

TRAINING OF PUPILS IN THE AGRICULTURAL DEPARTMENT, DOMINICA.

By F. G. Harcourt. *Agricultural Superintendent.*

In 1925 it was decided to reintroduce a system of training six pupils in the department and towards the end of that year four young men were selected by examination. This number was increased to six during the following year. A course of fairly extensive training was arranged to cover a period of two years.

Following the severe hurricane in 1928 and the wide-spread outbreaks of root diseases which followed causing the rapid dying out of seedling lime plantations, it was encumbent on the department to propagate large numbers of limes budded on hurricane and disease resisting stocks. In order to expedite this work it was necessary to engage a fairly large number of youths and to give them special training in citrus propagation. These young men were specially selected by examination for their general intelligence and were obtained from all parts of the island, many being the sons of overseers or peasant proprietors. Most of these youths quickly became efficient in budding and grafting, and the department considered that it would be definitely in the interests of agriculture in Dominica and of the young men themselves if they were given the opportunity of receiving some wider practical and theoretical training. Consequently the previous practice of giving six pupils a fairly extensive training was discontinued and all the youths selected for temporary employment in the department were given instruction in general agricultural matters in addition to specialised training in citrus propagation. The period of training is for two years and usually these youths are engaged on probation for several weeks before being accepted as pupils.

During the year 1933 the average number of pupils was eighteen and as three had completed their course of training, an entrance examination was held to fill the vacancies. No less than 23 candidates sat for this examination, which indicates the keenness existing for such employment and training. All pupils were given the opportunity of observing, and gaining experience in the practical work of the various sections of the department, including the Fruit Farm and Experiment Station. The students are paid a small daily subsistence allowance which is increased after the first year.

The principal practical work performed consisted of budding citrus and training the young trees in the nurseries. Two senior pupils were employed on special duties throughout the year, one at the Government Fruit Farm mainly in keeping cost accounts, and the other as seed-collector in the Botanic Gardens. Other practical work done included the preparation of nursery beds, sowing seeds, planting stocks, budding and grafting fruit trees, pruning fruit trees, potting plants, lining and draining citrus plots, preparation of planting sites, planting citrus trees, preparing and applying insecticides and fungicides, and keeping crop records, labour books and cost accounts. This practical work was closely supervised by the senior and junior officers of the department, and particular care was taken to train the young men in correct agricultural and horticultural practices. The main citrus nurseries of the department are situated in the Lime Experiment Station, and pupils were given opportunities to observe the routine work of the demonstration plots and the progress of the various trials.

An extensive schedule of lectures drawn up early in the year had to be modified owing to pressure of work in other directions. The syllabus of lectures given was as follows:—

1. General Botany (courses continued from previous year). Instructor: W. E. Bassett.
   Senior course: 19 lectures.
   Junior course: 22 lectures.
2. Picking and preparing Citrus Fruits for Export. Instructor: E. E. Taylor.
   7 lectures and demonstrations.
3. Sugar-Cane Cultivation.
   Instructor: E. E. Taylor.
   7 lectures.
4. Simple Arithmetic as applied to Agriculture.
   Instructor: C. M. Alexander.
   12 lectures and demonstrations.
5. Propagation of Fruit Trees.
   Instructor: G. J. Stedman.
   10 lectures and demonstrations.

The total number of lectures given was 77, and the pupils were required to write a summary of each lecture, the principal object being to provide them with notes for future reference. These notes, which were corrected and marked by the instructor after each lecture, also indicated the extent to which the subject had been grasped. Examinations held on the completion of each course showed that a fair knowledge of the subjects was gained. As usual the pupils were from various parts of the island, and standards of general education represented among them varied considerably; two had received secondary school education. It was therefore difficult to frame courses of lectures in such a manner as to make them suitable for the pupils as a whole. This difficulty was, however, lessened by arranging senior and junior classes for most subjects, and by dictating notes to the most backward pupils where necessary.

One of the principal objects in giving this training was that on its completion, the young men could return to their own villages and apply improved cultural methods in assisting parents and relatives in the cultivation of their holdings. Obviously these young men could not receive quite so thorough a training as was previously given to a smaller number. Nevertheless the training received made them better fitted to engage in agriculture either on estates or at their homes, and it is worthy of note that a number are now holding responsible positions either in Dominica or abroad.

OBSERVATIONS ON WILD CACAO AND WILD BANANAS IN BRITISH GUIANA.

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Introduction.

In view of the importance now attached to wild types of cultivated plants, consequent on the genetic and other researches of Vavilov, of Harland, and of Cheesman, the following notes may be of some interest, since they relate to stands of wild plants not previously visited by a white man.

Wild cacao.

In the Kew Bulletin (1930) I reported briefly on a visit to a stand of wild Amelonado cacao, discovered by Stahel ten years previously on the Coppename River, in the interior of Dutch Guiana. These trees, of which offspring are now growing at the Imperial College of Tropical Agriculture and at Kew, were of the type which Pittier and others distinguish as a separate species under the name of *Theobroma leiocarpa*. This widely-scattered stand showed marked uniformity in fruit and in vegetative characters.

In the same paper I included some notes by Mr. John Ogilvie on wild cacao on the borders of British Guiana and Brazil, and similar observations by the brothers Schomburgk. Since that date the British Guiana-Brazil Boundary Commission has found it towards the head of the Essequebo, while Senhor Ignacio Ferreira informed me that balata-bleeders report extensive groves on the entirely unexplored Rio Mocaja-i, which flows into the Rio Branco, and separates the great equatorial forest from the savannah country. In 1932 I first had an opportunity to visit this region, entering from the Amazon and Manáos, by ascending the Rio Negro and Rio Branco to the Rupununi Savannahs of British Guiana. There Mr. John Melville told me that some of his Wapisiana balata-bleeders had very recently discovered a considerable patch of wild cacao in the Kanuku Mountains—a grove of which neither their tribe nor Mr. John Ogilvie had any knowledge. I had only a limited time at my disposal, between Christmas and New Year, when it was very difficult, on account of social activities, to obtain assistance from the Indians. Mr. Melville, however, was able to supply me with two Wapisiana guides. In the following, I have tried to give a brief vegetational description of the environment.

It may be mentioned that the Kanukus—a long, wide *massif*, 3000 feet high, running east and west, and dividing the Rupununi Savannahs into two portions—are much less explored than the far more inaccessible Roraima region. There are practically no available data as to their extent and altitude, while so far as I can gather, the only trained naturalists who have visited them, and then only on short excursions, were the brothers Schomburgk, Carl Appun, Mr. T. A. W. Davis of the British Guiana Forestry Department, and the writer and his assistant.

We rode over undulating savannah from Wichabai, on the Rupununi River, into the foothills, left the horses and entered tall rain-forest, with Rubiaceous-Melastomataceous shrub undergrowth, and *Costus* and *Heliconia* spp. near creeks. Cocorite (*Maximiliania regia*) was the dominant and very common palm, and *Apeiba Tipourbou* an abundant tree. After a mile or so of this we made an abrupt ascent of some 500 feet to an elevated *Trachypogon-Byrsonima-Curatella* savannah, the site of a small Wapisiana village. We penetrated for some distance into the forest beyond, and camped for the night.

The next day, which was a long one, walking and climbing from before dawn to well after sunset, and covering between 35 and 40 miles by a winding route, we proceeded in towards the heart of the range. For some time our landmark—there were no trails—was Mount Kuruwin (about 2,000 feet), but this we eventually climbed and passed.

Tall rain-forest alternated with small savannahs, of which we crossed five, mostly very bushy, with *Trachypogon plumosus* dominant among the grasses. The rain-forest was at first all of a very open type, though the lofty canopy was closed; the ground being covered with dead leaves among the scattered saplings and seedlings, or with a pure stand of cocorite palms, in all stages of growth. This forest continued to the summit of Mount Kuruwin, with many very tall trees, including an abundant small-flowered *Lecythis* and an occasional balata (*Mimusops*).

Descending the mountain, we found a small *Geonoma* palm very plentiful on the slopes, and lower still tiresome brakes of 20-foot *Arthrostylidium*, with thin, bending stems. The *Lecythis* was still among the dominant trees. We passed the heads of various creeks—rocky springs rising in tiny swampy flats covered with tall manicole palms (*Euterpe edulis*).

At such a creek-head, but rather lower—I estimated 1,500 feet—with less swamp and more rocks in the form of boulders and out-crops, and with many lianes (notably a flat-stemmed *Bauhinia*) about the surrounding forest, we came to the cacao "reef". I could unfortunately identify few of the neighbouring plants, but the *Lecythis* above-mentioned was abundant, with an occasional *Centrolobium* (*paurainha*) (unexpected in this humid environment) and *Heliconia Bihai*. According to my guides the reef extended a long way down stream. We had very little time if

we were to reach camp that day and Wichabai the next, as the Indians, for festal reasons, insisted on doing; so I concentrated my attention on a few trees at the nearest end.

These were all large and profusely multi-stemmed. One base sent up no fewer than 41 trunks, up to a foot in diameter. The branches were long and spreading—in one place touching the ground 45 feet away, without sending down props. The younger stems were erect. In some cases the branches rooted where they touched ground, or they sent down stilt roots as in the Coppename River stand, and erect shoots from their upper surfaces.

Some of the stocks must have been exceedingly old. One base, consisting of a solid mass of intergrowing new and old stems, was five feet in diameter.

There were flowers and young fruit, but no ripe pods. A half-ripe one had been bitten open, the Indians said by a monkey. These animals, of several species, are especially abundant in the Kanukus. I found several old dry pods, all identical in form with the Surinam wild cacao, and obviously *T. leiocarpa*.

There was no sign of witchbroom disease, nor of cacao-beetle, nor thrips. In their freedom from witch-broom these trees afford a marked contrast to the Surinam wild cacao, which was badly attacked by the disease.

Wild bananas and plantains.

While the origin of cacao is, of course, unquestionably neo-tropical, that of bananas and plantains (*Musa* spp.) is just as definitely oriental, but there is some evidence of pre-Columbian bananas, in their use by the aboriginal Indians from time immemorial, in tribal myths of immense antiquity, and in reports by various travellers of wild bananas growing in apparently virgin forest. My friend, Dr. R. Requena, in a book recently published in Caracas, suggests that American bananas are survivors of the lost Atlantis, but this hypothesis is hardly likely to find acceptance in orthodox botanical circles.

As an example of the prominent rôle of the banana in Amerindian mythology, I may mention briefly the deluge tradition of the Taulipang Indians, as recorded by Koch-Grünberg (*see* Bd. II, pp. 33-38).—Makunaima, the tribal hero or demi-god, and his brothers felled the world-tree, which bore all fruits on its branches. The stump remains to this day as Mount Roraima, with its flat top. Water gushed out as they cut it, inundated all the surrounding country and formed the Great Flood. If only the tree had fallen on this side (the south) say the Taulipang we should find here plenty of bananas in the forest, but unfortunately it fell to the north, and many banana trees sprang up there as a result. For this reason, there are there to-day many banana-groves in the forest, never planted, and in that country there lacks no hing that man can desire. (*see* also Bd. III, S. 52).

Von Martius (1831, 3 Theil, pp. xx, 1063) was convinced that the plantain (*Musa paradisiaca*) was pre-Columbian, though he saw, on his extensive travels, no really wild examples.

Sir Robert Schomburgk (*see* Richard Schomburgk, Vol. II, p. 274) found wild bananas near the head of the Mazaruni River, British Guiana. He saw both bananas (*Musa sapientum*) and plantains (*M. paradisiaca*). The former were "flourishing among *Heliconia* and *Ravenala* whence they stretched for more than half a day's journey along the bank of the little stream, Paruima. The soil consisted of a yellow ferruginous clay mixed with sand and quartz fragments. Some of the plants reached a height of 50 feet and their stems a thickness of four feet, with the result that they formed so thick a fence that the party had to cut their way through. My brother found no seed-grains in the fruits, the shape of which at the same time also differed essentially from those of the cultivated plant, in that not only were they considerably larger, but not so sharply triangular. 'It was not men, but Makunaima when he yet lived on earth, who brought the plants here'. However much the statement that the *Musa* is not alone peculiar to the tropics of the old world but also to those of the new may militate against all past experience, the occurrence of so luxuriant a growth over an area of more than 50 square miles is nevertheless very remarkable: the absence of seed-grain in the fruits of course, conflicts with the assumption that it is indigenous. The Indians had also shown us previously several places where they were growing wild, *e.g.*, Mt. Vivi on the Rupununi".*

* Another passage from Schomburgk (Vol. I, p. 66) is worth quoting as probably the first reference to Panama disease, or something very similar. "For some years past an extremely peculiar disease has introduced itself in the *Musa* plantations [on the coast of British Guiana]: this has become particularly dangerous owing to its having proved so infective that if one shaft is attacked the whole plantation follows suit and perishes . . . When the tree is attacked its outward appearance immediately shows it and the whole plantation has to be cut down to prevent the further spread to others. The disease itself starts from the innermost vascular bundles which take on a brownish colour intermixed with a number of black spots. This decomposition of the sap soon extends to the whole shaft. The growth of the plant as well as that of the fruit is arrested and a resinous exudation renders the latter absolutely uneatable. If the same piece of land is going to be replanted, suckers from a healthy plant must be used, because experience has taught that even the suckers contain the diseased material of the mother-plant. Unfortunately my stay was too short to make myself absolutely certain of the real cause: in my opinion the whole phenomenon comes through a parasitic mould, which has its origin in the altered chemical relations of the soil consequent on the existing state of cultivation. Ten years ago the pest was completely unknown, but at the present time has gained such strides that it becomes the serious duty of the proprietors to have enquiry made into its origin on scientific lines". These observations were made 94 years ago.

Wild bananas in the New World offer a striking contrast to sugar-cane which is almost as widely distributed among the Indians, but which seems never to establish itself in a wild state in the neo-tropical region. On abandoned provision-fields of the Indians it never survives more than a year or two at the most.

Wild Plantains.

In the Rupununi District of British Guiana I first heard of wild *Musa* (in this case plantain) from Mr. Charles Melville. Riding over the southern savannahs in December, 1932, he pointed out to me a jagged, isolated mountain-block, an outpost of the Kanuku Range, rising abruptly out of the plain. This, he said, was Shiriri Mountain, meaning in Wapisiana, the Mountain of the Wild Plantains (or more exactly, of the Wild Bananas, from *sir* or *shir*=banana, *shirwir* or *sirwir*=a place where bananas grow, *cf.* Portuguese, *bananal*. Plantain=*siraimen*).* On that journey I was unable to investigate further.

Preliminary enquiries among the Indians a year later, by Mr. E. E. Melville, who later accompanied me to Shiriri Mountain, elicited the information that wild plantains (not bananas) grew on the mountain from time immemorial and had never been planted. In contrast they said, there were plenty of wild bananas in the Kanukus, growing among tall forest trees, but these were all relics of long-forgotten cultivations, whereas those at Shiriri were not.

More detailed data were obtained from the Wapisianas at Ambrose Village, a small settlement, the nearest to Shiriri, though ten miles away. One of the older men said Shiriri was the original home of plantains, they grew there in the country which they liked—rocky nooks with much water and mukka-mukka (*Montrichardia*). Other old men, questioned by Mr. C. Melville, asserted that Shiriri was the first place where men settled after the Great Flood, and they planted the first plantains there. None of the Indians had ever made provision-fields there, as they do in the Kanukus. Shiriri was only a hunting-ground, from which also, for generations they had procured plantain-suckers for their fields in the Kanukus. These plantains suckered, however, only on Shiriri, and they had always to return there for new suckers. Closer questioning of these and other Wapisianas, by Mr. E. E. Melville in their vernacular, showed that no one had actually obtained planting material from the mountain since before the great drought of 1926. We found however, a Wapisiana named Peixoto, who had this year, for the first time in the tradition of the tribe, made a provision-field on the rocky slopes of the mountain, and planted it with plantains, on the notion that they ought to flourish thus in their original home. His wife, one of the few surviving full-blooded Atorais, a tribe which occupied this territory before the Wapisianas, seemed to be the authority on the wild plantains, and was able to extend the traditional story very considerably. She said they were Gods' plantains, planted by Him. There may have been some missionary influence here, but Mr. Melville stated explicitly that she employed a term which was used to express the concept of a Supreme Being (literally "Maker") before the comparatively recent arrival of the missionaries. Her ancestors had "always" obtained suckers there. The plantains were of the ordinary kind, but the fruits exceptionally large and fine. As they were "God's plantains" it was inevitable that punishment in the form of sickness must overtake at least one member of any party which climbed the mountain to obtain planting material. Once such party was caught by a great gale of wind, which nearly blew them off the steep slopes.

So much for the tradition. So far as I could learn, Shiriri Mountain had never been climbed by a white man. Our first guide failed utterly to find any trace of plantains, nor did the general environment seem at all suitable. In the first place, the mountain was exceptionally rocky, with numerous bare black outcrops. Dry *Trachypogon-Curatella* savannah extended well up the main slopes, with *Agaves* and *Melocactus* on the ridges. The upper slopes were clothed with a dryish semi-deciduous scrubby forest, with such trees as *Cochlospermum*, and *Bursera simaruba*. We later found moister valleys with rain-forest at higher levels.

On a second attempt the Atorai woman and her husband guided us to what appeared to be the only survivors of the famous plantains. They were astonished to find so few plants, and blamed the fires consequent on the great drought of 1926. Traces of these and other fires were observed three-quarters of the way up the mountain. We saw only four plants, growing at an elevation of 1,400 feet, in a small sheltered gully, at the head of a valley, just below the source of a tiny rivulet. The plantains were growing among enormous rocks by the side of a thin trickle of water, in the midst of a grove of tall *Heliconia* sp. (perhaps *H. Bihai*, but not in flower). A little higher up was a bed of flourishing *Ischnosiphon*. Both this and the *Heliconia* were the only members of these moisture-loving genera we found on the mountain in several extensive excursions. These plants were shaded by comparatively tall rain-forest trees including *Spondias mombin*. Higher up the sides of the ravine were three or four tall palms, *Acrocomia sclerocarpa*.

The bases of the four trees had about 14 suckers. Two dead ones, and an old decayed base, showed no trace of borers, *Cosmopolites*, *Metamasius* or *Castnia*. The sheltered nature of the spot was evidenced by the entire edges of the great plantain leaves. The pseudostems were uniform green, well-screened by dead leaves, and very closely sheathed by the edges of the petioles; the upper part of the petiole cylindrical, without ridges.

* I am indebted to Mr. E. E. Melville, Government Land Officer, for this derivation.

Mr. Melville gave orders that these surviving trees were not to be molested. The question of the antiquity of this stock is beset with difficulties, especially due to the frequent, successive waves of migration which have passed over this region, the present tribe, the Wapisianas, being comparative newcomers. These Indians, and their predecessors, the Atorai, were certain that no one had ever lived on Shiriri, at least since the survivors of the Great Flood landed there. This we were able to prove incorrect, since Mr. E. E. Melville found on one of the ridges, exposed at the edge of a rock outcrop, numerous fragments of coarse heavy pottery, similar to those found in numerous localities in British Guiana, associated often with polished stone implements, the very use of which is unknown to the present tribes. The Wapisianas, surprised at this find, asserted that the pottery must have been left by the original inhabitants of the plains, the "Parauién", who were killed out by the "Caraibe"* the survivors taking to the hills. These "original inhabitants doubtless correspond to the Paravilhanos, recognised as a former tribe immigrant into this region. Koch-Grünberg (Bd. III, p. 110) says that the Taulipang, savannah Indians to the north-west of the same region, refer to these people as "Palawiyang" which allowing for differences of transliteration, is obviously the same word as "Parauién"; and they ascribe to this vanished tribe the manufacture of the coarse pottery, of which fragments are spread over the savannahs and were found by us on Mount Shiriri.

Wild bananas.

The wild bananas of the Kanuku mountains, already mentioned, were visited twice (in December 1933, and January 1934),owing to the fact that we had established close to them a camp for the study of a very heavy and interesting froghopper infestation. According to the report of the local Macusi Indians, they had been growing wild there for at least 40 years, and probably for much longer, but the Macusis considered the original stock to be derived from a forgotten provision-field.

These bananas grew for several miles along the banks of the Napi, near its head in the northern foothills of the Kanukus. We had first to walk, from the edge of the savannah, some five miles through high lowland rain-forest, similar to that covering vast areas in British Guiana, at first of a mixed type and later a rather pure stand of tall mora (*Dimorphandra* sp.). We eventually struck the Napi Creek where it was about 18 feet wide, rocky, with occasional sand-banks, and we waded up it for about a mile to the main patch of bananas, a large grove shaded by tall second-growth forest. There were two kinds, the smooth, whitish apple-banana (resembling the Trinidad "silk fig") which is the common eating banana of the district, and the stout red one. There were many hundred plants, growing so luxuriantly and so close together, and suckering so profusely, that the ground between the pseudostems was largely bare. Both forms were perhaps the healthiest and most vigorous banana-plants I had ever seen, and the two kinds of fruit were excellent. Downstream from this grove, for two miles and more bananas were scattered, in places plentifully, among the second-growth trees (*Cecropia*, *Triplaris*, *Inga* spp.) of varying age growing on the natural flood-plain of the river. Most, if not all of this second-growth forest seemed to be due rather to the devastating annual floods, when the small creek, swollen to a wide torrent, rushes down with destructive force, than to human clearing. These downstream bananas were undoubtedly planted by the flood-waters. I saw one sucker about four feet high, which had evidently been wrenched out bodily and swept down, to a point where it had stranded 100 feet from the normal river bank. In its prostrate position it had taken root, the original pseudostem had died, and at right angles to it rose two healthy green shoots three feet high.

That part of the flood-plain which bore the main grove, though differing in no way from that bordering both banks of the stream both above and below, may have been, as the Macusis asserted, a long abandoned field. There were, for instance, small weedy sweet potatoes,* and the weed-grass, *Eleusine indica*, growing on the adjacent strand. The Macusi women from the nearest savannah village, nine or ten miles away, make frequent visits to the grove to obtain fruit and suckers.

I saw no sign of diseases. Of insect pests, the large borer (*Castnia licoides*) was fairly frequent, not only in the bases, but six to eight feet up in the pseudostems. The secondary weevil borer (*Metamasius hemipterus*) was scarcer. A skipper caterpillar (Hesperiidae, close to *Calpodes*) was rather plentiful, folding the leaves. It was attacked by a Tachinid fly not yet identified.

Other records.—Red bananas of the same kind were noticed by Robert Schomburgk (1931, p. 36) in 1835, in a neighbouring part of the range, growing there, in the fields of the then more frequent settlements, "to the utmost perfection".

In the Pakaraima Mountains on the journey to Mount Roraima, in 1932, I saw two patches of wild bananas, growing in forest, to all appearance

* "Caraibe" is the Wapisiana term for Brazilians (Whites), who up to less than a century ago, made slave hunting excursions in this territory. They use another title for the true Carib Indians.

* "Napi" according to Schomburgk, signifies in Macusi "sweet potato". If this be true it argues a high antiquity for these wild sweet potatoes. A similar case is that of Anai, not far distant on the Rupununi River. This name is said to mean maize, and to have been given in allusion to the wild maize alleged to grow there. (Schomburgk, Robert, 1931, pp. 120, 28). Certainly no wild maize grows in the region now.

virgin. One was a very extensive grove, apparently of the above-mentioned "apple" banana, (I saw no developed fruit) a few miles from the Taulipang settlement of Arai, on the Brazilian side of the frontier. The other consisted of a number of magnificent plants of the stout red banana, growing in a river-bed, in the forested country of the British side.

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REVIEWS.

MODERN BEE-KEEPING.

By Herbert Mace, F.E.S. Revised Edition, 1933. Published by the Bee-Keeping Annual Office, Harlow, Essex. Illustrated, pp. 225. Price 5*s*.

Bee-keeping is an essentially progressive craft, and this revised edition of a popular manual takes full account of the improvements in technique which have occurred since its first appearance. An entire section of the volume is devoted to advanced bee-keeping, and another to the diseases of bees. This gives in detail Frow's method for the treatment of Acarine Disease, a fairly recent advance in bee-keeping methods, which will probably have far-reaching effects.

An attractive feature of the volume is a fly-leaf presenting useful memoranda for apiarists in a readily accessible position, a feature which might be copied with advantage in many other technical handbooks. Instructions are given for constructing a hive of modern design, and the book concludes with a short list of recipes in which honey is the principal ingredient.

A. P.

* * *

A STUDY OF PRICES AND WAGES, CHIEFLY AGRICULTURAL, IN BRITISH GUIANA, 1910-32.

By H. D. Huggins, M.Sc., Dip. Agric. (*Agric. Jour. British Guiana*, V. 2, 1934.)

The author's object in writing this article seems to be as much to indicate the usefulness of "index numbers" in a study of price fluctuations as an actual analysis of the fluctuations themselves. A good case is made out for employing this means of comparing price changes in different commodities, and several interesting points emerge from his enquiry into the interrelations of export and import prices, wage levels and the cost of living in British Guiana during the post-war period.

After studying the movements of export price levels in the ten most important commodities on an index basis of the average prices ruling between 1910 and 1914, a similar analysis is made of the two principal factors affecting cost of living, namely price changes in imported articles and in commodities produced and consumed locally. In addition, "weighted indices" for each year are computed so as to give in a single figure an idea of the general economic situation, each commodity contributing to the total in proportion to its relative value to the Colony. Contrasting the weighted indices of imports and exports in each year, it is shown, for example, how in 1932 the situation improved, the index for imports rising by two points, the index for exports by six points by comparison with the figures for 1931.

Further details need not be quoted, but to those whose business it is to gauge rightly the significance of price fluctuations, this paper, though it breaks no new ground, should be of pertinent interest.

N. W.

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A FIVE-YEAR BIBLIOGRAPHY OF THE THEORY OF REFRIGERATION, REFRIGERANTS AND APPLIANCES.

Compiled by H. T. Pledge, 1929-1932. Science Museum, South Kensington, *His Majesty's Stationery Office*, London. pp. 97. Price 2*s*.

A further addition to the 120 bibliographies compiled by the scientific staff of the Science Library from their extensive card index and published for the benefit of research workers, this publication contains some 1,800 references to papers on refrigeration in general, refrigerants, refrigerating machines, ice manufacture and refrigeration in air conditioning; the decimal classification number is given in each case. It is to be supplemented by a second part on the effect of refrigeration on the bacteriology and biochemistry of foods, &c., and the applications of refrigeration, so that in conjunction with bibliographies already published *e.g.*, Nos. 19, 67, 88, 97 and 113, these should provide an invaluable index to all matters connected with the subject.

E. R. L.

WEST INDIAN NOTES.

(Compiled by the Advisory Department, Imperial College of Tropical Agriculture.)

Sugar Industry.

The factories in St. Lucia ceased operations in May, favourable weather conditions enabling the crop to be reaped in record time, and 5,176 tons of first sugars were made.

In Antigua 9,686 acres were reaped of which 6,586 acres were ratoons, and the crop, which finished at the end of June, can be summarised as follows :—

	Antigua Sugar Factory.	Bendals Sugar Factory.	For whole of Antigua.
Production, tons ..	18,197	2,480	20,677
Tons cane per ton sugar ..	7.22	8.85	7.4
Tons cane per acre ..	..	..	15

In St. Kitts the Factory manufactured 28,262 tons of sugar: the average yield per acre for the crop, which finished in early July, was 26.23 tons, and an average of 7.2 tons of cane were used to make a ton of sugar. During the crop 4,316 tons of canes were shipped to the St. Kitts Factory from Nevis.

* * *

Sea Island Cotton Industry.

The crop in Montserrat, which suffered considerably from the extended dry season, was showing signs of fairly general recovery at the end of July, when ginning commenced from cotton in the Leeward districts. At that time pink bollworm was still negligible though green bug had caused a fair amount of damage. A local estimate of the crop at the end of July was given as around 450,000 lb., but owing to the backward condition of the cotton in districts other than on the Leeward coast the final 1934 yield is difficult to estimate, since with the later and drought delayed plantings, losses from bollworm and other causes may be heavy.

The Montserrat Cotton Export Ordinance (No. 7 of 1934), was passed by the Legislative Council on the 20th June. Steps were taken at the end of July to allocate in early August the "prescribed quantity" for 1934, viz.: 360,000 lb., which is exclusive of exports on direct sale.

In St. Kitts, where about 200 acres were planted, picking was general in July and attack by pink bollworm was reported as slight.

The Nevis crop was mostly reaped during the June quarter and the returns, although fairly good, were not up to expectations owing to damage in some cases by heavy rains in January. The bulk of the island's crop was this year again handled by the Government, 143,436 lb. of seed cotton being purchased, giving 40,224 lb. of lint. An advance payment of 4 cents per lb. was made.

In Anguilla the ginning of the 1933-34 crop ceased in June. Damage by pink bollworm was very extensive and the percentage of stained cotton was very high. The crop totalled 117 bales lint (29,975 lb.) and 17 bales stains (4,906 lb.)

A visit was paid by Mr. H. E. Box, Colonial Development Fund Entomologist, to Montserrat in early July to study the position regarding the possibility of biological control of pink bollworm. Unfortunately, from the standpoint of his visit, practically no bollworm was present this year at that time. However, in Mr. Box' opinion, biological control and the close season cannot very well be worked together owing to the destruction of host plants with the latter control method. As Mr. Box states, the close season must in all probability be retained and, as such, biological control cannot very well be undertaken. He suggests the stiffening of control legislation by addition of the power to destroy areas heavily invested with bollworm during the cropping season.

Arrangements were made for visits to be paid by Dr. S. C. Harland, Geneticist of the Cotton Research Station, Empire Cotton Growing Corporation, Trinidad and Cotton Adviser to the Advisory Department, Imperial College of Tropical Agriculture, to Antigua, St. Kitts and Montserrat during the latter part of August. Dr. Harland's visits were made primarily in connection with the selection and maintenance of the quality of the local strains of cottons.

* * *

Fruit and Vegetable Industry.

Banana shipments have shown little increase since the last quarterly notes, this being largely due to the use of as much of the available material as possible for planting. The quality of the fruit has improved considerably since the end of the dry season.

Shipments of green limes in barrels to New York up to the end of July, together with shipments over the same period for the past two years, are given below :—

From.	1934 to end July.	1933 to end July.	1932 to end July.
Dominica ..	2,591	3,013	4,514
St. Lucia ..	2,915	2,300	2,123
Montserrat ..	1,831	823	141

Probably largely owing to the hot summer experienced this year in America, the demand has been well maintained, prices not dropping below around $7 f.o.b. per barrel as compared with around $5 in the main season in 1933. The demand in Canada has also been good.

Shipments of summer crop oranges from Dominica to Bermuda and the Maritimes began in early August and good prices were offered.

The mango crop this year was short of expectation and has extended over a relatively long period owing to successive blooms, this being particularly the case with the grafted mangoes. Shipments to Bermuda to the end of July are given below :—

From.	Package.	1934 to end July.	1933 to end July.
St. Lucia ..	Miscellaneous, average about 1½ cu. ft. ..	2,331	3,388
Dominica	2 cu. ft. ..	967	457

Two co-operative shipments of grafted fruit were arranged to England, fruit being shipped from St. Lucia and St. Vincent and also from Demerara and Grenada. The condition on arrival was good but details of sales are not yet available. Exports to Canada have been below those in 1933, largely owing to shortage of supply.

Probably because of the prolonged dry season a short avocado pear crop is anticipated.

At the end of July the account sales for all shipments of tomatoes from Montserrat, except two small shipments made in June, had been received. Net returns after deducting all packing, shipping and marketing expenses are given below :—

Shipments made in	Net returns for shipments per lb.		
January ..	2.1	2.1	..
February ..	3.0	1.7	1.7
March ..	1.5	3.4	1.5
April ..	2.1	3.2	..
May ..	4.0	3.5	3.0
June ..	3.0	3.0	(estimated)

The bulk of the shipments were made in March, April and early May. The net returns given above are pool average returns for any one receiving period, comprising an average sometimes of shipments to Halifax, St. John and the B.W.I., and local sales. The equivalent of 8,097, 20-lb. lugs were exported, of which 5,383 were packed and shipped by Government, and a further 1,240 lugs were also sold by Government. Reckoning the June net returns (which only involve 2,460 lb. of tomatoes), at 3.0 cents per lb. the average net return to growers is 2.6 cents per lb. for the fruit packed and marketed by the Depôt and 2.7 cents per lb. for the total fruit marketed by the Depôt. The average returns given above are quite satisfactory, reckoning, for example, an average yield of four to five thousand pounds per acre.

Eight hundred lugs of tomatoes were shipped during the past season from St. Vincent and returns are expected to approximate to those of Montserrat. The 300 lugs shipped from Nevis early in the year (December to March) netted a return of 1.9 cents per lb.

The total exports of onions from Montserrat were 1,261 bushels for the season. Five hundred and forty-three bushels were marketed by the Depôt (403 in Barbados, 140 in St. Lucia) which yielded an average net return to growers for graded onions, delivered packing shed, of $1.12 per bushel or about 2¼ cents per lb.

At the end of July some 1,907 bushels had been shipped from Montserrat to the Maritimes and the B.W.I., of which Government had marketed 1,339 bushels. Many sales were still outstanding but it seems probable that net returns to the grower of about 70 cents per bushel for Maritimes sales and around $1.10 for B.W.I. sales should be obtained.

Miscellaneous News.

Mr. F. G. Harcourt, Agricultural Superintendent, Dominica, was awarded the M.B.E. in the recent Birthday Honours List.

* * *

Mr. F. L. Squibbs, Assistant Agricultural Officer, Dominica, has been appointed as Assistant Director of Agriculture, Seychelles, with effect from the 4th March, 1934.

* * *

Mr. A. K. Briant, recently Assistant to the Commissioner of Agriculture, proceeded to St. Vincent on 14th July to take up his new appointment as Agricultural Superintendent.

* * *

Mr. C. Alexander, who is in charge of the operations of the Canadian Banana Company, Ltd. in the Eastern Group of the British West Indies, paid visits to St. Vincent from 17th to 24th June and to Dominica from 18th July to 2nd August.

* * *

Mr. A. C. Shill, Marketing Officer and Acting Commissioner of Agriculture, visited Montserrat and St. Lucia from 19th to 26th July and 27th July to 3rd August respectively. Mr. Shill was recenty offered and has accepted the post of Adviser in Agricultural Marketing and Controller of Agricultural Exports in Malta. Mr. Shill left for England on 21st August.

* * *

Mr. H. E. Box, Entomologist, who has been working during the last three years on the control of sugar-cane moth borer in Antigua, St. Kitts and St. Lucia, has recently been appointed for a further period of two years. Mr. Box, whose headquarters will in future be in St. Lucia, arrived there on 20th July after surveys of borer control by *Lixophaga* in Antigua and St. Kitts and of the pink bollworm problem in Montserrat. He is now attached to the Agricultural Advisory Department of the Imperial College of Tropical Agriculture.

Captain H. V. Metivier, O.B.E, Government Veterinary Surgeon, Trinidad, visited St. Lucia from 13th to 23rd June. The visit was much appreciated and Captain Metivier's advice and recommendations should be of decided value to the island. He stressed in particular the need for more rigid selection and elimination in breeding, the provision of adequate food supplies and attention to hygiene.

Brevities.

The broker's report on the new Hybrid Marie Galante cotton selection from Carriacou, which was received in June, was generally very encouraging as regards the colour and the length, strength, quality and character of the staple. The value was estimated at around 9½*d.* per lb., that is, about 1*d.* more than Sakel.

Two lots, each of 5 lb., of seed of the new Carriacou selection C. 1. 14 were forwarded at the end of June for trial in Anguilla and Tortola.

* * *

As a result of his recent sugar-cane moth borer control surveys, Mr. Box reports that, "in St. Kitts, the parasites (*Lixophaga*) have multiplied and spread since their original introduction, and it may be stated that Lixophaga is now present in every cane growing area in the island, destroying up to 65 per cent. of the borers in individual fields, and with a steady average of 18.0 per cent." The corresponding figure for average per cent. parasitism in the 1933 survey was 7. 2 per cent.

Mr. Box reports that, as in 1933, "the situation in Antigua this year is very different from that in St. Kitts, the parasites being much less in evidence. Nevertheless, the data indicate a decided increase in numbers of and effective parasitism by Lixophaga in Antigua in 1934 as compared with the previous year" (average parasitism by Lixophaga, 1.1 per cent. in 1934, 0.2 per cent. in 1933). He further states that, "there is no reason to believe that the controlling factors are climatic or topographical, and it is probable that certain natural enemies (*e.g.*, a small brown lizard, *Anolis* sp.) are at work."

During his visit to St. Kitts in June, Mr. Box superintended the introduction of Lixophaga in Nevis, at Cole Hill and Nisbetts Estates, and a supply of puparia was left for release in the same locality.

* * *

A further introduction of cacao pods, from trees in Trinidad specially selected by the officers of the Cacao Research Scheme was made to Dominica in early July. Apart from distribution to planters, two plots, each 100 feet square, are being planted in the Botanic Gardens with rows of seedlings from fourteen parent trees. In St. Lucia, where no suitable Experiment Station land is available, all the seedlings are being distributed to the principal cocoa producing estates.

YIELD OF RUBBER FROM VEGETATIVELY PROPAGATED CLONES.

Very rapidly the scientific study of vegetative propagation in the tropics is enabling variable material grown from seed to be replaced in the plantations by more uniform plants multiplied by vegetative propagation from selected parents. In the case of rubber, both budded and grafted material has been successfully propagated, and it is significant that the *Journal of the Rubber Research Institute of Malaya* of March, 1934, contains papers by Mann, Billington and Kaimal and by Rhodes and Mann, upon the yield of latex from such vegetatively propagated clones. The point seems already established that, as might be expected, the trees of a clone, all multiplied vegetatively from one parent plant, are more uniform in growth habit and show a good correlation between growth in girth and yield of latex. It is found, however, in tapping the new plantations, as yet of very young trees, that the yield of the parent may not apparently be a reliable criterion of its value as a founder of a clone. From a group of 19 trees selected from 500, only four have been given buddings which appear to possess the necessary high-yielding characteristics. This means that progress may be slow, but none the less it should be sure, and the figures supplied by Rhodes and Mann certainly suggest that there is great uniformity in behaviour in the trees of a clone. As the selected clones are studied, naturally various types are eliminated for reasons connected possibly with other characteristics than yield. This appears to have led to some uncertainty amongst practical growers as to the future of the new methods, but an estimate by C.E.T. Mann of yield under commercial conditions from clone plantations shows that the outlook for the new practice is definitely favourable.—(*Nature*, Vol. 134, No. 3,375, p. 31, 1934.)

CLASSIFICATION OF SESAME.

A recent study of the sesame (*Sesamum indicum*, L.) by Hildebrant (*Bull. App. Bot., Gen. and Plant Breeding*, 4, 4; 1932, Institute of Plant Industry, Leningrad), is based on 500 samples of seed collected by various expeditions; more than a third of these came from Central Asia and Asia Minor. As a preliminary to classification, the author deals with the variation in the characters of the plant in relation to geographical distribution. The species is divided into two sub-species according to the number of carpels in the capsule. A morphological basis is used for division into varieties. The mass of sesame in all countries is composed mainly of two varieties, the other varieties occurring mostly in mixtures with these varieties. The author considers Africa to be the primary centre of origin of the species, with India and Japan as secondary centres. Palestine appears to be the centre of high oil-yielding strains, the percentage of oil diminishing as one goes farther away from that country.—(*Nature*, Vol. CXXXIII, No. 3368, 1934, p. 764.)

A NOTE ON THE MARKET FOR CITRATE OF LIME.

[Being a *Report of the Imperial Institute, London.*]

BEFORE the War Italy enjoyed a monopoly as the world's producer of citrate of lime. Citric acid was manufactured chiefly in the United States, Germany, Great Britain and France, all of whom imported citrate of lime from Italy for this purpose. The amount of citric acid produced at that time in Italy was unimportant.

After the War conditions altered in Italy's favour. The Sicilian Camera Agrumaria, which since 1908 had possessed the sole right of selling citrate of lime to the manufacturers of citric acid, decided in order to promote the Italian citric acid industry only to supply foreign buyers when all home needs were satisfied. At the same time citric acid manufacture in Germany was stopped a German firm removed its production to Italy, where manufacture proceeded apace and in 1928 the output exceeded 4,000 tons. Italy was now the leading world producer of citric acid and exported to two European producing countries (England and France) increasing quantities of the ready finished product instead of the raw materials, citrate of lime and lemon juice, hitherto shipped.

A change in production took place in 1927 when the United States had so far developed the manufacture of calcium citrate from surplus citrus fruits in California that they became independent of the raw material from Italy and could develop their citric acid industry unhampered. In 1929 the United States, with an output of nearly 5,000 tons, became the largest producers of citric acid in the world. The attempts of the United Kingdom to provide its own raw material from the lime juice imported from the Empire had only been partially successful, but now the availability of Californian citrate greatly eased the situation. Italy's share in British imports of citrate of lime fell from 98 per cent. in 1926 to 7 per cent. in 1930 and nil in 1932. The fall in the imports from Italy and the increase in those from the United States are clearly shown in Table I.

Table I.

UNITED KINGDOM TRADE IN CITRIC ACID AND CITRATE OF LIME.

	1926.	1927.	1928.	1929.	1930.	1931.	1932.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
IMPORTS OF CITRIC ACID.							
Total	279	301	541	626	257	1,088	463
From :							
Belgium	—	—	—	—	21	372	22
Italy	248	269	467	612	233	712	441
Other Foreign Countries ..	31	32	74	14	3	4	—
RE-EXPORTS OF CITRIC ACID.							
Total	31	10	20	85	34	60	30
IMPORTS OF CITRATE OF LIME.							
Total	2,495	2,148	2,016	3,110	1,939	2,171	2,923
From :							
Spain	53	138	—	—	—	—	—
Italy	2,440	2,007	1,021	1,156	141	99	—
United States	—	—	995	1,954	1,796	2,072	2,889
Other Foreign Countries ..	—	—	—	—	2	—	—
British Countries ..	2	3	—	—	—	—	34
EXPORTS OF CITRIC ACID. (Manufacture of the United Kingdom)							
Total	534	749	718	1,052	1,168	1,370	1,684
To :							
Germany	1	202	94	268	289	203	309
Netherlands	49	64	69	56	96	132	138
France	6	—	1	153	171	239	419
Spain	34	54	38	56	28	39	41
Other Foreign Countries ..	70	113	113	178	225	363	320
Australia	197	149	215	170	133	133	212
Canada	56	72	97	77	137	154	155
Other British Countries ..	121	95	91	94	89	107	90

This change from Italy to the United States as the main source of supply of the citrate of lime imported into the United Kingdom received an impetus from the action of the Italian Government, already referred to above, in endeavouring to develop the manufacture of citric acid in Italy and to limit the export of citrate of lime.

Only France remained working with Italian citrate of lime to any extent up to 1931, when 1,243 tons were imported, since when that country also has almost ceased to import the Italian product. In 1932, however, the Netherlands entered the market and has since taken the bulk of the supplies (*see* Table II).

Table II.

ITALIAN TRADE IN CITRIC ACID AND CITRATE OF LIME.

	1926.	1927.	1928.	1929.	1930.	1931.	1932.	1933.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
EXPORTS OF CITRIC ACID.								
Total	2,029	1,950	3,284	2,759	1,793	1,788	1,557	1,932
Of which to :								
United Kingdom	266	258	540	585	216	679	431	379
France ..	259	251	512	440	226	231	153	189
Germany ..	80	307	594	396	211	100	150	142
Netherlands ..	393	198	196	192	177	89	51	81
Spain	134	133	142	126	153	145	147	108
Argentina ..	276	220	339	218	196	113	113	266
EXPORTS OF CITRATE OF LIME.								
Total	4,524	3,056	1,601	2,248	1,272	1,403	650	1,551
To :								
United Kingdom	2,074	2,070	1,031	1,152	75	99	1	—
Austria ..	—	—	—	179	352	—	—	—
France ..	1,175	986	560	906	804	1,243	10	3
Netherlands ..	—	—	—	—	—	—	607	1,285
United States ..	1,175	—	—	—	—	—	—	—
Other Countries	100	—	10	11	41	61	32	263*

In 1928 the production of citric acid by the fermentation of sugar was begun, and owing to the low price of sugar the industry became firmly established during the next few years and citric acid was produced by this method at a price which endangered the position of the Italian industry. The increase in production of citric acid both in this country and America was considerable. This fact is reflected in the figures for exports of citric acid from this country (Table I) which show a sudden increase from 1928 to 1929 onwards.

* Including 256 tons to Czechoslovakia.

Although Italian exports of citric acid (Table II) fell off subsequent to 1929, the total world production showed a considerable increase. This factor together with the cheaper cost of manufacture by the fermentation process brought about a big fall in the price of citric acid during 1930 (Table III). Citrate of lime, which is sold on a standard equivalent of citric acid, also fell heavily in price, and the position as regards the Italian citrate was further aggravated by the accumulation of stocks, created by the lack of demand in this country and on the Continent, for Italian citrate. Italian producers suffered heavy losses, and the price of citric acid fell from 20 liras per kilo in 1928 and 1929 to as low as 4.5 liras during 1933; in March, 1934, the price w as 6.25 liras per kilo. Citrate of lime has dropped from 4½ liras per kilo in 1928 to 1 lira at the present time.

Table III.

PRICES OF CITRIC ACID.—(In December of each year.)

	UNITED KINGDOM.	ITALY.
	per lb.	liras per kilo.
	s. d.	
1926 ..	1 2½ to 1 3	18 —
1927 ..	1 6 to 1 7	16 to 17¼
1928 ..	2 3 to 2 4	20½ to 21¼
1929 ..	1 11 to 2 0	19½ to 20
1930 ..	1 1 to 1 1½	10½ to 12
1931 ..	1 1¼ to 1 1½	10½ to 12
1932 ..	0 9¾ to 0 10	10 —
1933 ..	0 9½ —	4½ —

CITRUS NOTES.

A Spray Programme for Citrus Trees.

R. H. Linderman.

This spraying programme, in force at Mountain Lake, Florida, is claimed to have reduced scale to such an extent that oil spray is no longer necessary, to have reduced melanose below the degree prevalent in neighbouring orchards and to have greatly improved the colour and texture of the fruit. It consists first of lime-sulphur 1 : 25 applied about mid-January for grapefruit and 1 : 40 for oranges. This first spray achieves a considerable control over scab. Dry lime-sulphur is also used, 2 lb. equalling 1 gal. solution. The second application is made at 1 : 40 when three-fourths of the blossom has fallen. Thereafter general applications at 1 : 40 are made at 7-week intervals throughout the summer until 1st September. One further application will keep the fruit in condition till harvesting. The July application is made at a time when the young scale insects are most active. The spray is applied with a pressure of 400-500 lb. — (*Imperial Agricultural Bureaux, Hort. Abs.*, Vol. III, No. 3. Ab. 376.)

* * *

Girdling Washington navel orange trees.

By A. D. Shamel and C. S. Pomeroy. (*Calif. Citrograph*, 1933, 18; 328, 347, 348.)

The experiment started in March, 1928 and has continued uninterruptedly to the present date. The operation consists of incising the trunk through the bark to the wood in a single encircling cut, direction being maintained by a guide strap buckled round the trunk. The girdling is best performed in May at a time when the blossom on the south side of the tree is dropping, while that on the north side is fully open. The girdles are made an inch apart in successive years, the first cut being 12 inches from the ground. The trees in the experiment were planted in 1903 at Corona, California, are of Washington Navel strain free from disease and of fine physical appearance. Alternate trees in the plots have been treated, the remainder being used as controls. Results have shown a slight increase of yield in girdled trees up to the third successive season, with a pronounced increase in light years. The omission of girdling from trees previously girdled has resulted in a reduction of crop. Continuous girdling after the third year may lead to an increasing loss of crop. This observation is supported by data from trees which have been girdled eleven years in succession. As between girdled and ungirdled trees no marked differences have been found in size or flavour of the fruit or in the appearance of the trees. Differences detectable by chemical analyses are slight; there was no increase in disease in girdled trees.—(*Imp. Bur. of Fruit Prod., Hort. Abstracts*, Vol. IV, No. 1, 1934, 9. 37.)

CATTLE IN THE TROPICS.

Professor R. Cecil Wood has just published an illustrated, authoritative pamphlet of 42 pages on "Cattle in the Tropics", (Price Two Shillings, post free) copies of which may be obtained from the Author, Imperial College of Tropical Agriculture, Trinidad, B.W.I.

SUGAR NOTES.

Compiled by the College Department of Sugar Technology.

Ripeness Test with the Refractometer.—*K. J. Moet.*

This is the seventh of a series of memoirs having to do with investigations on the ripeness of P.O.J. 2878, and deals more especially with a comparison between the old method of field sampling of sugar cane and the new refractometric method. In the old method a number of whole stalks (50 or more) are taken at different points in a field, carried to the laboratory, crushed in a small mill, and the juice analysed. In the original refractometric method no stalks are cut. The operator goes through the field and bores out small portions of the pith of the stalks; this is squeezed to obtain a drop or two of juice which is examined on the spot with a hand refractometer. The refractometric reading gives the brix of the juice, which is known to be strictly proportional to the rendement (for normal canes).

In a newer form of the refractometric method the juice of each stalk is not examined separately, but is stored in a small flask until 25 or more stalks have been bored; the mixed juice is then tested in the field or the laboratory.

Comparisons between the old and new methods of sampling show that the new method is preferable both on the score of convenience and that of reliability. In this work the sampling by refractometer was carried out on the basis of 24 stalks per hectare, from four selected groups of stools. All harvestable stalks in a stool are sampled, the point of sampling being about the middle of the stalk.—(*Facts about Sugar*, Vol. 29, No. 7 1934, p. 243.)

* * *

The "B-S" Pocket Refractometer.—*N. Deerr and L. Bellingham.*

In design, the pocket refractometer, closely follows that of the larger instrument. Two glass prisms between which is placed a drop of the liquid to be tested, are mounted in a hinged box. On directing the instrument towards the light the edge of the dark shadow formed by the well-known critical angle effect is focussed by means of an objective upon the scale which is divided to read 0.25 per cent. soluble solids. The scale and border line are focussed by means of an orthodox eye piece, and the position of the border line can be read to 1/10 scale divisions without difficulty. A light filter renders the edge of the border line colourless, so that monochromatic light is unnecessary. The instrument is robustly constructed and is sent out in correct adjustment. Check readings should be taken occasionally with distilled water which should read 0 at 20°C. If this is not the case the small screw near the eye end of the instrument will enable a correct setting to be made. The overall length of the instrument is only 16 cm., and its weight is 112 grms.; it is supplied in a soft leather case so that it can be carried conveniently in the pocket.—(*Int. Sugar Jr.*, Vol. XXXVI, No. 427, 1934. p. 276.)

Effect of Trash on Factory Operations. *G. D. Becker.*

This paper records information on the effect of introducing field trash into the cane deliveries, 3 lots of 7.5 tons each of D 1135 cane being separately ground, and worked up in the after-factory separately, the first being the cleaned cane, the second the roughly cleaned cane with 8 per cent. of trash, and the third the uncleaned cane with 16 per cent. of trash. It is to be understood that the cane is flumed from field to factory. Following are some of the principal figures obtained for the 3 different runs: Brix of crusher juice, 17.58, 15.79, 14.81; Brix of mixed juice, 11.65, 11.57, 9.52; purity of the mixed juice, 87.67, 86.76, 85.41; extraction, 97.25, 97.47, 97.45; boiling house recovery, 94.51, 93.96, 93.18. The large differences between the Brix of the crusher juice are of course due to the flume water introduced with the trash. The uncleaned cane introduced a larger amount of fibre which threw extra work on the milling station and prolonged grinding. True, there is a greater amount of bagasse with uncleaned cane, but it holds so much water that its calorific value is much reduced. (*Inter. Sugar Jour.*, Vol. XXXVI, No. 426, 1934, p. 246.)

* * *

Some (Technical) Statistics of the Queensland Sugar Industry.—*J. M. McGibbon.*

The author reviews mill data of Queensland sugar factories during the period 1915-32. The field results—"tons of cane per acre"—have shown very little change but "tons of cane per ton of sugar" has shown a considerable drop and is now consistently below eight and has gone below seven. This improvement in "quality ratio" is ascribed to (*a*) increased milling rates, by which the length of the campaign is reduced and the cane harvested more nearly at its peak of maturity; (*b*) cultivation of varieties richer in sugar; (*c*) ageing of soils; (*d*) maturity testing so as to harvest each variety at optimum ripeness. A higher milling efficiency is a contributing factor. (*Facts about Sugar*, Vol. 29, No. 7, 1934, p. 241.)

* * *

Juice Pumps.

Wear in juice pumps is caused mainly by sand and grit in the juice, and with brass plungers and liners maintenance costs of the pumps are heavy. In one mill a Hummer screen was installed and maintenance costs were greatly reduced. In another mill the installation of a small tank in the juice gutter to collect the sand greatly reduced the trouble; this tank required frequent emptying. Cast iron plungers and liners show great wearing quality. Centrifugal pumps are also subject to wear from sand; hard cast iron casings, with cast iron or stainless steel impellers, give the best results. Monel metal seems to be the best for spindles.—(*Facts About Sugar*, Vol. XXIX, No. 8, 1934, p. 279.)

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

Characteristics of Cocoa Butter.

Cocoa butter is cheaper at the present time than it has been for some years. Nevertheless, the sale of substitutes still continues, either because they possess special desirable properties, or because they are very cheap. Commercially, cocoa butter varies somewhat according to the method of manufacture, the type of bean used as raw material, and the conditions of growth of the crop. Thus well-roasted beans usually yield a superior butter than under-roasted beans. The use of direct steam or of high-pressure steam to break down the fat-containing cells also affects the final product. Alkalinisation, sometimes practised to aid fat-extraction, may further affect the quality of the butter, and extraction by fat solvents may yield a slightly different material than extraction by mechanical pressure.

The main features that are important in deciding quality in commercial cocoa butter are hardness, degree of contraction on solidifying, sharpness of melting point, brittleness, and temperature of setting. In order to increase its hardness, hydrogenation is sometimes practised. By this means, the melting point of the butter can be raised from 30.3°C to 60.8°C, with accompanying great increase in hardness. Unfortunately, hydrogenated cocoa fat shows no contraction on setting, which is a very undesirable feature in chocolate manufacture. Furthermore, it is unsuitable as a foodstuff, because of its low digestibility and high melting point. Carefully-controlled partial hydrogenation may be useful, however, for improving very soft cocoa butter.

Cocoa butter substitutes exhibit little contraction on setting, and tend to produce "bloom" on finished chocolate. Lack of contraction prevents moulded chocolate coming away cleanly from the moulds, and results in dull, rather than glazed and shiny, surfaces, and blurred patterns or fancy markings instead of sharp reliefs. Surface white bloom spoils the appearance of the bar or fondant. Pure cocoa butter may be supercooled, and the liquid slowly brought to the setting point without any trace of visible crystallisation, which is the chief cause of bloom. The tendency to bloom may partly be counteracted by thorough incorporation of the fat into the chocolate mixture. Rapid cooling ensures a good gloss and snap, but too low a cooling temperature, and too rapid cooling encourages crystallisation and blooming. In practice, the conditions must be rigorously controlled so as to strike a mean between the contributing effects. The storage of finished chocolate also must be carefully controlled because high temperatures inevitably encourage the development of bloom. The critical temperature appears to be 24.5°C (76°F); at this point the lowest melting fractions begin to liquefy and to rise to the surface, and the heavier cocoa particles and sugar sink in the molten mass.

In recent years, the practice of incorporating lecithin (a phospho-lipin abundant in egg-yolk) into chocolate mixtures has been introduced in order to increase their fluidity, as well as to aid the uptake of fat, to save the use of cocoa butter, and to diminish the tendency to bloom.—(*Food*, Vol. III, No. 33, 1934, pp. 333-334.)

* * *

Movement of Nutrients in the Cotton Plant.

A short summary of certain phases of the important investigations on the physiology of the Cotton plant that have been conducted during the past few years at the Cotton Research Station in Trinidad, is presented by Dr. T. G. Mason and Dr. E. Phillis, in the April issue of *The Empire Cotton Growing Review*, Vol. XI, No. 2, pp. 121-124. The growth cycle of the Sea Island Cotton plant, in the West Indies extends over six months. During the first half of this period, growth is predominantly vegetative, and most of the soil nutrients (nitrogen, phosphorus and potassium) are absorbed by the roots. This uptake ceases when the bolls are set during the second half of the period. Vegetative growth and the energy of root absorption utilise sugars manufactured in the leaves. The absorbed mineral salts travel up the wood in the transpiration current, and are concentrated and stored in the leaves. Nitrogen is there partly transformed into protein. Fruiting utilises sugar, which is diverted from the roots and travels to the bolls, thereby causing a cessation of root growth and of mineral absorption. The bolls gradually drain the plant of its food materials, the leaves die, and the bolls are starved and finally shed. Since sugar is moved from a region of low concentration within the green leaf-tissue to one of increasing concentration within the veins, work must be done, and this is effected by energy liberated during oxidation of part of the carbonaceous food material (respiration). The actual channel of sugar transportation is the sieve tubes of the phloem tissue of the leaf-veins and stems. Oxygen seems to be carried within the plant by certain substances (oxygen-carriers) akin to the haemoglobin of blood.

The mobile minerals that are distributed from their stores in the leaf *via* the phloem channels, comprise the elements nitrogen, phosphorus, potassium, magnesium, chlorine and sulphur. On the other hand, calcium and iron are apparently not mobile, and remain more or less stationary in the leaf. The behaviour of the mobile elements potassium, magnesium and chlorine, is different from that of the mobile elements, nitrogen and phosphorus, in that they readily diffuse outwards from the phloem vessels into the woody tissues of the stem, and thence back again into the leaf, in the transpiration current. Prior to abscission both of leaves and flowers, a rapid backward movement of mineral elements occurs in the Cotton plant.

TREND OF THE MARKETS.

[The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.]

SUGAR.—Prices on the Home Market have ranged as follows:—(c.i.f. per cwt.)

	Foreign.	*Preferential.*
	s. d.	*s. d.*
26th July	4 10½	8 7½
2nd August	4 9	8 7½
9th August	4 9	8 7½
16th August	4 9	8 6
23rd August	4 9¾	8 5¼
30th August	4 9¾	8 5½
6th September	4 9¾	8 5¼
13th September	4 5½	8 3
(*14th Sept.*, 1933)	5 4½	10 1½

Business generally has been of extremely moderate proportions. Deliveries of Refined sugars have been very active of late due to contracts for heavy deliveries during July and August. This has caused Refined buyers to be more or less independent of the market and indifferent to offerings of Raw Sugars. In spite of this and the continued uncertainty as to the terms of the Cuban Treaty, the tone of the market remains steady, but quiet.

* * *

RUBBER.—Quotations for Plantation Sheet have ranged as follows:—

	d.
25th July	7 1-8
1st August	7 1-16
8th August	7 3-8
15th August	7 1-2
22nd August	7 5-8
29th August	7 9-16
5th September	7 1-2
12th September	7 1-2
(*13th Sept.*, 1933)	3 19-32

Disturbing influences, more particularly the political situation in Germany and Austria, and the panic in the American grain markets, have continued, to have a negligible effect on the Rubber market, which throughout has remained firm with a slight advancing tendency. Such speculation as there is, either on the London or New York market, is in the nature of investment buying, and the general position is considered sound.

* * *

COCOA.—There is very little change to report in the cocoa market since last writing. As usual the market is very quiet during the month of August, and with Hamburg practically cut off, due to Exchange difficulties, there is little opportunity of stimulating interest in other directions. Accra is quoted at 21*s.* c.i.f., and the nominal price locally is $6.40 a fanega.—(*By Courtesy of the Cocoa Planters' Association of Trinidad, Ltd.*)

COFFEE.—Offerings at auctions remain small, but buyers requirements were quickly met. Jamaican sorts sold best, of which mountain grown, good bold, fetched up to 249*s.* per cwt. Kenya bold sold up to 70*s.*

* * *

COTTON.—The following are the official spot prices in pence per lb. of the Liverpool Cotton Association.

	American Mid.	*Egyptian F.G.F. Sakel.*
27th July	6.97	8.50
3rd August	7.07	8.63
10th August	7.42	8.96
17th August	7.11	8.61
24th August	7.12	8.77
31st August	7.15	—
7th September	7.11	—
14th September	7.09	—
(*15th Sept.*, 1933)	5.47	7.30

Issue by the United States Department of Agriculture of statistics relating to the 1934-35 crop, showing figures below expectation, resulted in a rise of prices in New York and London amounting to about ¼*d.* per lb. Recently reaction has brought about an easier tendency which may partly have been caused by the break in the wheat market. Spinners are using less American cotton than 'outside growths', and from a supply point of view the American cotton situation is definitely 'bullish'.

* * *

COPRA is a dull market. West Indian f.m.s. is quoted at £9 8*s.* 9*d.* c.i.f. buyers, for September shipment. — (*West India Committee Circular*, 16th August.)

* * *

BANANAS.—There is a good demand for Jamaicas and the quality of the fruit continues to improve. The Jamaican Producers' and Elders & Fyffes have increased their prices to wholesalers by 10*s.* per ton and now quote £18 5*s.* delivered London and £18 nearest station Provinces. Brazilians are unchanged at £18 and in fair demand. —(*West India Committee Circular*, 16th August.)

* * *

LIME PRODUCTS. *Lime Oil.*—Handpressed is scarce on the spot and valued at about 35*s.* per lb. There are sellers of Distilled at 20*s.*, but the demand continues slow. *Lime Juice.* There are buyers of concentrated at £4 15*s.* Raw is quiet, but the last value of 2*s.* 6*d.* to 2*s.* 8*d.* per gallon for really fine is unchanged.—(*West India Committee Circular*, 16th August.)